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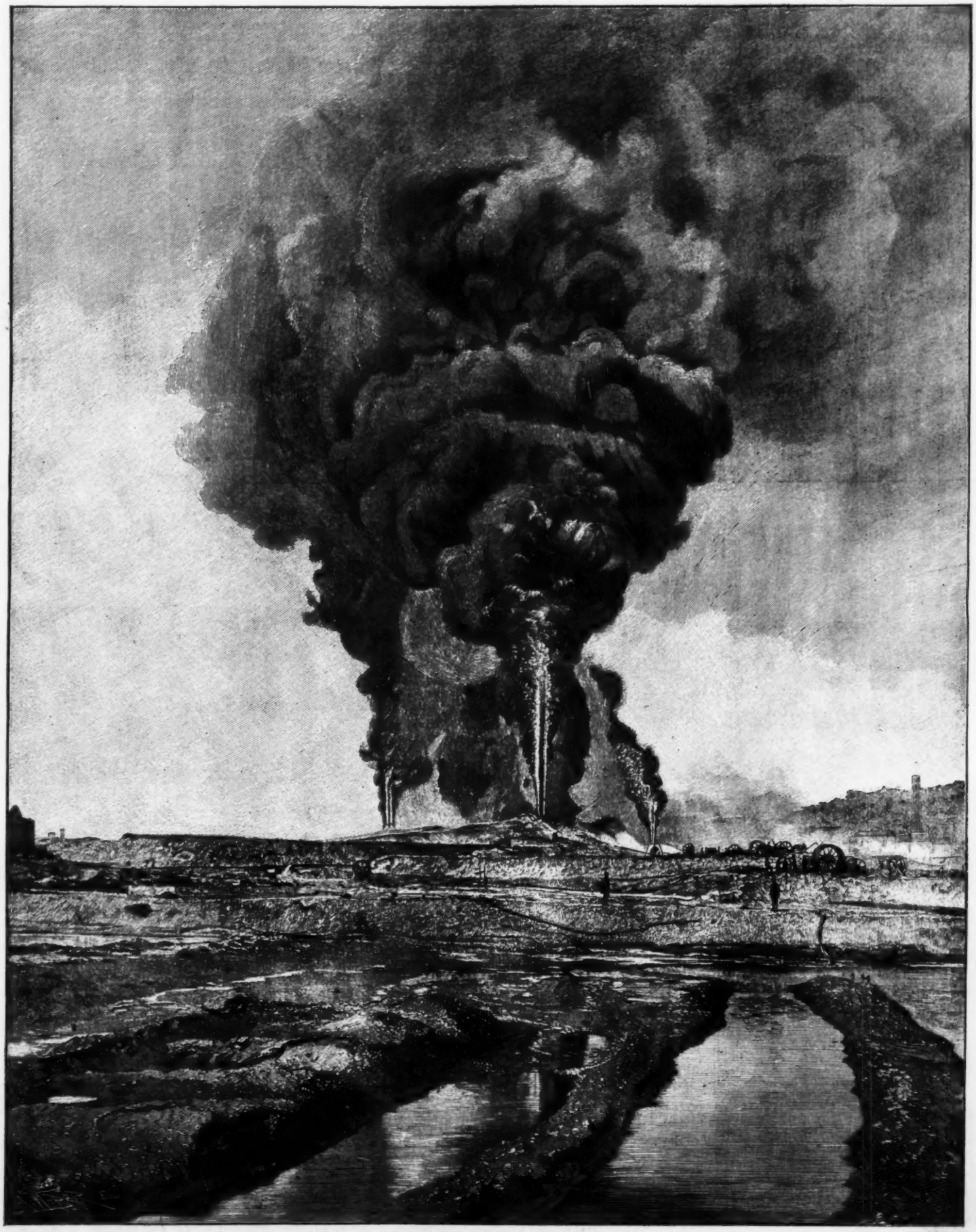


THREE BURNING OIL-WELLS IN THE FIELDS OF BIBI EYBAT.

THE OIL-INDUSTRY OF THE PENINSULA OF APSHERON.

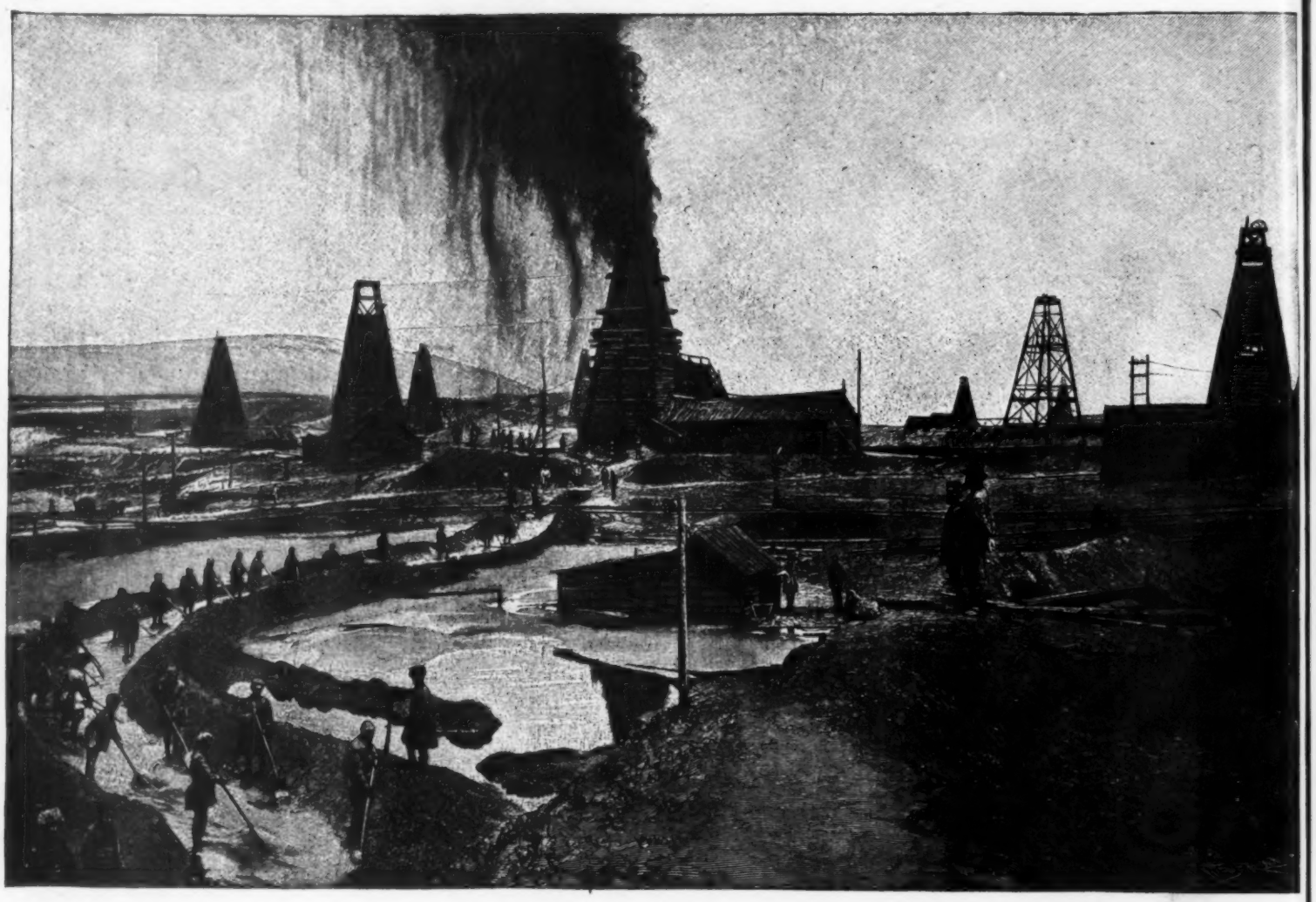
WITH the exception of coal and of iron, no substance is perhaps of such importance to mankind as petroleum. Although known in ancient times, this natural product has only within the last half century developed from a medicinal curiosity to an article which has become indispensable. We now find petroleum used both in the palaces of the rich and in the huts of the poor; and within the last few years its field of application has been so extended that it is employed not merely as an illuminant, but in almost every industry. Modern engineers have long endeavored to obtain the greatest efficiency from the fuel used. Of the two methods by which they seek to attain their end, the one increases the efficiency of steam—our most widely-used motive agent—by superheating; the other rejects steam entirely and instead employs explosive gases as sources of power. The petroleum-motor belongs to the second class. The day is not far distant when dyes, medicaments, and saccharine substances will be manufactured from petroleum as well as from coal-tar.

Crude petroleum is found in large quantities in North America, the Caucasus, Galicia, Roumania, on the Sunda Islands, in Japan, Germany, and other regions, and is manufactured into benzin, illuminating-oil, lubricating oil, vaselin, and paraffin. The depth at which petroleum is found varies from 50 to 500 meters.

Although the obtaining and manufacturing of the oil varies to a certain extent in different parts of the world, nevertheless the underlying principle is the same in all cases. The typical method of boring for petroleum and the process of converting the crude material into the refined products which are sold in the markets of the world, may be best observed in the oil-fields of the peninsula of Apsheron on the Caspian Sea, the second largest petroleum district in the world.

In order to raise the brown-black, aromatic oil from the depths of the earth, a hole is bored into the soil by means of a drill. If the soil be sandy, sections of iron pipe are driven into the ground until the first layer of rock is reached. Through this pipe or tube heavy drills are dropped, which are attached to a block and tackle and rigged at the top of a derrick. To the top of the drill a temper-screw is fastened by means of a rope, and secured to one end of a walking-beam—a heavy timber oscillating on its own axis. The other end of the walking-beam is connected with the driving-pulley of an engine. In operation the end of the walking-beam rises and falls, giving an up-and-down movement to the drill-holder and drill. At intervals a reamer is inserted in the well, to bring the bore to the proper size and shape. The oil is brought to the surface either by pumps—the method commonly practiced in the United States and Galicia—or by means of a scoop attached to the drill-rope. Often the pressure is so great that the brown oil spurts forth with terrible force. Such powerful streams often attain a height of 100 meters (328 feet) and in twenty-four hours yield as much as 17,000 metric tons of oil. A well is often in eruption for months; and its fortunate possessor soon becomes a millionaire, if not already one. But sometimes the earth-basins, which are always provided to catch the oil when it bursts forth thus violently, are of insufficient capacity, in which case floods, in the truest sense of the word, result. These oil-floods, in connection with the inflammable gases which stream out simultaneously, are a source of great danger to the inhabitants of an oil-district owing to the many fires in the boiler-houses and refineries. It therefore happens not infrequently that an oil-well which has broken out, takes fire, a spectacle beyond description. The huge fiery stream shoots up with a thundering noise, and burns with a heat so fierce that no human being dare approach within several hundred feet. To extinguish the flames is impossible; and man is compelled to stand by impotent until the bore becomes clogged with sand or stones; and the fire dies out of its own accord.

On the peninsula of Apsheron are two oil-fields, that of Balakani-Sabuntchi-Romani and that of Bibi Eybat. In the accompanying illustrations, taken from *Illustrirte Zeitung*, portions of both districts are represented. From the wells of Apsheron 7,100,000 metric tons of oil are annually obtained. From the wells the crude oil is pumped a distance of seven and one-half miles to the "Black City," where it is distilled by a hundred factories into kerosene, benzin, lubricating oil, and liquid fuel (masut). The various products obtained from the crude oil are shipped to Astrakhan and thence to the interior of Russia, or to Batum, on the Black Sea, from which place they are sent to all parts of Europe, Asia, and Africa.



OIL-WELL IN ERUPTION IN THE FIELDS OF BIBI EYBAT.

THE RELATIONS OF PHYSICS AND ASTRONOMY TO THE DEVELOPMENT OF THE MECHANIC ARTS.*

By Prof. CLEVELAND ABBE,
United States Weather Bureau, Washington, D. C.

IT is but four months since, on the 18th of January, you celebrated the seventy-fifth anniversary of the Franklin Institute. This is, therefore, an anniversary year, and it will not be long before January of the year 1906, when you will have an opportunity to celebrate the two hundredth anniversary of the birth of Benjamin Franklin, whose name is held in reverence and inscribed above your portals.

You now propose to inaugurate a new branch of activity for the Franklin Institute. Not long since you added the mechanical and engineering section to those already existing, and you have now added a fifth, to be entitled "The Section on Astronomy and Physics." The organization of the Franklin Institute will, therefore, hereafter include not merely a "Committee on Sciences and the Arts," and "Sections on Engineering and Mining and Metallurgy," but also special sections on important branches of science, such as astronomy, general physics, electricity and chemistry.

* Address delivered at the inaugural meeting, May 19, 1899, of the Franklin Institute and published in the Journal of the Institute, to which we are indebted.

You have thus recognized the existence of certain relations between the advanced sciences and the practical arts. The Franklin Institute is devoted primarily to the promotion of the mechanic arts, but you have recognized that the sciences are so closely related to the mechanic arts that it is to your advantage to give them a distinct recognition in your organization.

I. THE MECHANIC ARTS CLOSELY RELATED TO PHYSICAL SCIENCES.

This inaugural meeting of your newest scientific section is, therefore, an appropriate occasion on which to consider with some detail the precise character of the relation between physics and the mechanic arts. I do not say astronomy and physics, because that branch of astronomy which we shall consider is itself known as celestial physics. We have celestial and terrestrial and molecular physics, three branches of knowledge that are all included under the comprehensive term physics, or the science that treats of force. Ages ago man recognized only those forces in which large masses of matter are involved. He studied projectiles, falling bodies, the equilibrium of forces, the buoyancy of vessels, the motions of waves and tides and winds, and even the motions of the heavenly bodies. But now he has learned that all chemical phenomena have to do with the motions and equilibrium of molecules; that heat and light and electricity and the photographic or chemical action of light are but the motions of individual molecules of ponderable matter and of the imponderable ether atoms that drive the material molecules hither and thither; that sound is but the motion of larger groups of molecules. Everywhere he is confronted by the laws of force.

If you strike a smart blow with a hammer upon the head of a cold chisel and make a cut into a piece of soft iron, you are doing one of the simplest mechanical operations, and yet you are awakening a long list of reactions that invade every branch of physical science.

1. The muscles respond to the eye and the will; the hammer moves with great acceleration and strikes straight and hard; the energy of the blow comes from the chemical transformations going on within the workman's body, suggesting problems that belong to the profoundest depths of biology.

2. The stroke of the hammer calls forth a clear and cheerful sound from the head of the chisel—a musical ring with all its problems in acoustics.

3. The hammer, the steel chisel, the soft iron and the chips become warm and hot under the repeated blows, suggesting problems in thermodynamics and the radiation and conduction of heat.

4. The edge of the hard chisel becomes dull, but a deep gash is cut in the soft iron; eventually the face of the chisel breaks; all of which results are explained by the study of the science of elasticity as applied to the flow of solids and the exhaustion of metals.

5. A better chisel is picked out and the hammering goes on all day without harm to the tool; such choice could not be made without a thorough knowledge of the chemistry and physics of steel.

6. If the anvil be a stone and both it and the ham-

mer be properly insulated and connected with an electrometer, every stroke would be seen to produce electricity; this sets us to thinking about piezo-electric phenomena, and we perceive that as every change of pressure produces electrical phenomena, therefore the electrified condition of the whole earth, with its resulting atmospheric lightning, may be in part the result of the crunching of the geological strata that we call the earthquake, an idea that was first suggested by Clerk Maxwell.

I need not weary you with illustrations of that which must be patent to every thoughtful mind; the general principle holds good everywhere and at all times that no invention can be made, no action taken, no great work accomplished on this earth, without involving many principles in nature that have already been recognized by scientists and others that still remain to be discovered.

You, therefore, do well to combine both physical science and the mechanical arts into one institution. Your object must be, on the one hand, to apply physics to the proper construction of machines and the daily needs of the artisan; on the other hand, you may hope to add something—perhaps much—to our knowledge of physics, through your ingenious machinery, your abundant experience and your keen thought.

The manifold and intricate connection between the sciences and the arts may be treated from several points of view. Let us first glance at the historical development of this connection.

II. EVOLUTION OF THE MECHANIC ARTS.

The mechanic arts may be said to have existed before the dawn of history; they were coeval with the evolution of the Aryan language. We trace the art of weaving, as we now know it, back to the time, 3,000 years ago, when it was already well advanced in India, but the word to weave is far older than that. We trace the potter's wheel back to the earliest archæological potsherds, perhaps 5,000 years, and know nothing of its far earlier history. We trace the arts of cutting, sawing and planing from our present magnificent machines back to the first knives of jade used by the prehistoric Asiatic and American races. We trace our hoes, plows and cultivators back to the sticks and the forked branches that were used to scratch the soil by the first tribes of men, but how many thousand years ago no one ventures to say.

The modern railroad car, the elegant wagons and the fleet bicycles only became possible after the ancient architects had first learned to put rollers under the massive stone blocks and had put rude wheels to the carts drawn by oxen and the wheelbarrow pushed by man.

The art of sewing leaves together or that of spinning threads must have been an early suggestion after man had learned to twist grass and twigs together to form crude ropes.

Our extravagant military engines, from the immense ironclads down to the Mauser rifles, go back step by step to the stones and slings, the bows and arrows, and the boomerangs of primitive man.

I should say that the mechanic arts had no definite beginning; they have gone through a process of evolution so gradual and gentle that we can at no time say, "This was the beginning."

Mythology does, of course, tell us that Vulcan forged Jove's thunderbolts. To the mind of the child of to-day, just as to the childish minds of antiquity, everything on earth must have had a definite beginning, there must have been some one who first taught us how. Therefore, the ancients demanded a cosmogony, a History of Beginnings, a Divine Creator and a simple tangible method of procedure as to His inventions and creations.

But the modern scholar who has studied carefully all the ways of nature among the plants, animals and rocks of this earth and the stars of the universe beyond us, perceives that a series of changes, a gentle and gradual evolution, has prevailed everywhere. We are, therefore, prepared to recognize that this same principle applies to the industries and to the arts that have been developed through the agency of man. We are but the agents. The Creator is working, but through us, not for us. He moulds the world, not as the potter does the inert clay, but as the wise parent does the mind of the intelligent child.

III. EVOLUTION OF INVENTIONS.

The crude devices of primitive man were improved by successive inventions. In the history of invention, properly so called, the simple collocation and juxtaposition of two ideas is often the critical matter. It is not science, or study, or art—it is simply the happy accident that brings to some one's mind two thoughts that are suddenly seen by the inventor to have an important relation to each other, hitherto unsuspected. For instance, some one is anxiously looking about for a pigment that will produce a special tint of color. He is wandering along the roadside and sees the color he needs in a piece of stone or discoloring a ledge of rock. If his mind is ready to receive the suggestion, it becomes seed sown in good ground. The idea of grinding that stone into pigment immediately occurs to him. He proceeds to experiment, and not only grinds, but oxidizes and even roasts the stone. The invention was a matter of suggestion to the inquiring seeker, but the art was an application of physical and chemical science.

Man's needs have stimulated him to discover and invent. Those who enjoyed the best surroundings have generally brought forth the best results. Those nations and individuals who were unfortunate as to climate, soil, vegetation, minerals, water power, etc.—those who had neither stimuli nor opportunities—did little. In proportion as we to-day associate ourselves with the highest science, we bring forth the best inventions and manufactures.

Some one asks why we cannot make a steamboat that will go fifty miles an hour by the use of the screw propeller. The idea is good, but it is a mere matter of imagination, a dream, a useless suggestion until all the resources of physics and mechanics have been combined to evolve the modern high speed vessel.

Prof. S. F. B. Morse was an artist, but was also seeking to make some great invention. The idea of communication by means of electricity, with the speed of thought, early took possession of his mind, and he was always on the look-out for some method of realizing the indefinite hope that haunted him. Ten years were spent in making every conceivable combination of electrical devices — but nothing came of them. At length Dr. L. D. Gale suggested that Joseph Henry's recent researches on the electro-magnet be put to use. That distinguished scientist was consulted at Princeton, and immediately it was found that the laws that he had discovered in relation to electricity and magnetism and the apparatus that he had made were those appropriate to the Morse telegraph, that, in fact, he had one already at work. Even if you do not agree that we ought to speak of the "Henry telegraph" and the "Morse alphabet," you will at least grant that every step in telegraphy, from its beginning to the modern perfection of the art, has only become possible by means of the knowledge resulting from the investigations conducted by scientists, or by inventors who had to become scientific investigators before they could complete their work.

IV. INVENTION ASSOCIATES WITH INVESTIGATION.

We must be careful to recognize that the inventor is frequently also a scientist, and still more frequently is the scientist an inventor. The scientist cannot investigate without having instruments and apparatus, and must invent these to suit the needs of the case. The inventor frequently comes upon an obstacle that cannot easily be overcome until he has investigated some obscure point either in mechanics or physics. This principle is beautifully illustrated by the life and work of James Prescott Joule, who was the son of a brewer, and himself continued in that business for a long time. His scientific education under Dalton in England and Jacoby in St. Petersburg enabled him to fully appreciate the mutual relations of science and art. While others speculated on the use of the electricity from the galvanic battery as a motor, he, by studying the laws of thermodynamics, showed the exact connection between the amount of work that could be done by a pound of coal when burned in the furnace and a pound of zinc consumed, i.e., burned, in the galvanic battery. He then proceeded to the determination of the so-called "mechanical equivalent of heat," viz., the fact that a unit of heat can only do 772 foot-pounds of work. He is justly considered one of the founders of the modern doctrine of the conservation of energy, whose principles must be obeyed by every mechanical device that man may invent. When anybody proposes to manufacture something out of nothing, no matter whether he calls it perpetual motion, or the Keely motor, or the liquid air motor, you have only to show him that he proposes to violate Joule's law and he must subside.

A PORTION OF THE OIL-FIELD OF BALAKANI.

The changes of temperature produced by the condensation and rarefaction of gases, especially of steam, are vital to the working of the steam engine. These were early experimented upon by Espy, but more thoroughly by Joule and Kelvin; the arrangement of the cut-off of the steam engine must be made in accordance with Joule's laws if the machine is to work efficiently, as indeed he, himself, first showed in his paper of June, 1844. At that time he said: "The principles I have established lead to a theory of the steam engine very different from the one generally received. . . . Believing that the power to destroy belongs to the Creator alone, I entirely coincide in the opinion that any theory which, when carried out, demands the annihilation of force is necessarily erroneous. . . . The theory here advanced demands that the heat given out in the condenser shall be less than that communicated to the boiler from the furnace in exact proportion to the equivalent of mechanical power developed."

V. MECHANICS, EXPERIMENTAL AND EMPIRICAL, ASSOCIATES WITH SCIENCE.

I choose the following case to illustrate this theorem: In the "Philosophical Transactions of the Royal Society of London," for 1886, is a beautiful memoir on the theory or method of action of lubricating oils and other lubricators. This memoir, by Prof. Osborne Reynolds, seems to be the first satisfactory effort to unravel the physical actions involved in lubrication.

There had been an abundance of previous experimentation for two hundred years past, and many empirical rules and tables had been formulated respectively applicable to each set of experiments, but the special experiments made by Mr. Tower gave Prof. Reynolds the first suggestion as to the truth concerning the method of action of the film of oil that we insert between a journal and its bearings, in order to diminish the loss of power by friction. Reynolds had previously conducted a beautiful set of experiments on the flow of liquids in tubes and very small channels, and had shown that, although the resistance to flow is ordinarily proportional to the square of the velocity, yet there is a critical velocity at which it suddenly changes from the square over to the first power of the velocity. He was now able to show that lubrication is simply a case of the flow of a viscous liquid through a very narrow channel. When the journal presses upon its bearing the intermediate space is perhaps $\frac{1}{1000}$ or more likely $\frac{1}{10000}$ of an inch in thickness. This space, being filled with oil, constitutes the thin film that serves to convert the rubbing and tearing of the metals into the sliding and rolling of liquid molecules. It is as though we had inserted a myriad of minute steel friction balls between the journal and its bearings. You are all familiar with the thin films of the soap bubble. Perhaps you have observed that when the film is not too thin it may be said to consist of two surface films separated by a thicker layer of liquid. These two surface films may slide past each other. By careful watching you may see the beautiful spots of colored light rearranging themselves as the two surfaces draw nearer and nearer together and squeeze out the liquid between them. The thinnest part of the soap bubble is a film much thinner than that ordinarily dealt with in lubrication, while, again, the thicker parts are much thicker than lubricating films. By means of the apparatus invented by Plateau the properties of these thin films have been abundantly studied. The motions of the viscous liquid particles must obey the laws of mechanics, as first clearly expressed by Stokes, Kirchhoff, Helmholtz, Stefan and other students of hydrodynamics.

The results of these difficult researches in molecular physics have a direct application to the lubricating action of oils. Prof. Reynolds succeeded in elucidating the novel phenomena recorded by Mr. Tower and established an important verification of the assumptions on which our modern theories of hydrodynamics and molecular physics are founded. I may be allowed to speak more fully on this subject, because these ideas have not yet found their way into many text books on machinery. Let us take up one simple phenomenon, viz., the heating of the journal and bearings. We have hitherto imagined that after the journal has worn a smooth bed in its bearings, and there is no objectionable and injurious heating or abrasion, then its rapid revolutions proceed without the evolution of much heat. Now the fact is, that while the upper and lower surfaces of the lubricating film of oil remain in permanent contact with the steel journal and the brass box, respectively, or at least change very slowly, and there is no abrasion of the metals, still the thin layer of intermediate liquid is being rapidly torn away and renewed. The viscosity of the liquid resists this sliding of one layer of its molecules past the other, and thus gives rise to heat; the inner layer of the liquid film soon becomes a surface layer where the molecules are under great tension, and this change gives rise to more heat. As long as the journal is revolving, heat is being evolved by the compression and internal friction or motion of the molecules composing the lubricator itself. Often we do not observe this heat because it is carried away by conduction through the metals and by the least breath of air almost as fast as it is generated. Every one knows that the abrasion of dry metal surfaces evolves heat, but the abrasion of viscous films also does so. As the journal revolves rapidly it carries its thin film of oil into the crevice between the journal and the bearing; it is a V-shaped or wedge-shaped crevice, and as the film crowds into the wedge, Reynolds speaks of it as going into the "on" side, because right above this crevice is the load bearing down upon the film. As the film squeezes through the crevice, being forced along by the rotating journal, it quickly approaches the off side of the load, where the pressure is taken off it and it is again free to spread out over the journal; thus it is carried around until it again enters the "on" side and squeezes through a second time to the off side. You will see at a glance that the small area of film between the journal and the bearing on the "on" side must support the whole load, and this implies an enormous pressure, which, in the experimental work of Mr. Tower, was only 625 pounds to the square inch, but must be far greater than this in many of the cases that occur in actual practice. Of course, the laws that hold good for perfect lubrication will not obtain for the case of imperfect and irregular supply of oil, or for cases where the lubricant has not the proper molecular and physical properties needed when very great pressures are involved. But when there is a full supply of oil and the pressures are not too excessive, then you will easily perceive that the film adhering to the journal and about to enter the "on" side of the crevice is not as yet under any pressure or constraint, except only that it is held to the surface of the journal by reason of some molecular attraction between the metal and the liquid. Ordinarily, we say that the particles of liquid cohere among themselves, while the liquid and the solid adhere together. Now, the liquid will not easily be forced from the free surface of the journal into that crevice between the journal and bearing where the pressure per square inch is so great, and yet it does both enter and pass through, and there is nothing to bring about this remarkable result except the rapid motion of the journal and the adherence of the film to its surface. We must think of the liquid film as a small mass of matter thrown into the "on" side of the crevice with considerable velocity and, also, as dragged in by the journal. Its viscosity and its inertia combine to force it into the wedge-shaped space. It must be very considerably compressed therein. It must, also, have its molecules forcibly squeezed past each other as it passes through the narrowest part of the wedge and slips onward to the large space in the rear. Of course, also, its forward movement with the journal is slightly retarded in front and accelerated in the rear. But the most interesting feature is the pressure—the static pressure within every part of the film.

There must be a resultant pressure against the surface of the bearing and another against the surface of the journal. These would be normal to the surfaces and equal in intensity and opposite in direction if the journal were not in rotation, but when rotating, the pressure keeping the two surfaces apart is greatest in the front half of the lubricating film, while in the rear half it becomes negative, that is to say, it tends to bring the two surfaces together. This surprising result may, perhaps, be easily reconciled with our current ideas if we remember that the same powerful adherence which carries the oil with the journal forward into the funnel must also, in the rear of the latter, carry it away from the funnel. As much oil must leave the funnel in the rear as approaches it in front. There is a push in front, but an attraction in the rear. It is evident, therefore, that the force that keeps the journal from absolute welding contact with its bearing is the adherence of the oil to the journal and the coherence of its own particles. The resistance that we call friction in a smooth-running journal is an exaggerated case of that which we call viscosity in hydrodynamics. It is the force required to make one layer of liquid glide past another.

The other friction that occurs when no lubricant is used, or when the supply of the lubricant is too limited, of course, involves the tearing asunder of the particles or molecules of the metals themselves. This abrasion is not considered in the theory of lubrication.

Prof. Reynolds' hydrodynamic theory, as checked by Mr. Tower's experiments, seems to give us a complete statement of the relation between the frictional resistance, the load and the speed for any lubricant that is supplied in abundance, and he has given us a general formula applicable to all cases that can occur.

When there is but a limited amount of oil available, an increase in the load, i. e., the pressure, will diminish the thickness of the film around the journal in general, but will increase the length of the pad of oil that bears the weight, thereby increasing the area of the surface films, whose sliding past each other produces the frictional resistance, and, therefore, increasing the friction. The relation between the increase in friction and the increase in load for this case is more complicated than for the case in which an unlimited amount of oil is available, which latter case is experimentally realized by wholly immersing the journal and its bearings in a bath of oil.

The result of the whole research is to show that, not only in case of intentional lubrication, but whenever hard surfaces under pressure slide over each other without abrasion, they are separated by a film of some foreign matter, whether perceivable or not; that the action of the revolving journal is to maintain the film between the surfaces at the point of pressure; that if there is any abrasion when the surfaces are well lubricated and well filled, it must be due to the foreign particles in the oil—particles introduced at the first grinding or subsequently as dust.

I may add that when the lubricant has thickened or is entirely absent, we have a condition analogous to that of the swiftly revolving wheel of soft lead, which is used to cut into the harder metals, to which I will refer later.

I give this long review of Reynolds' work as but one among many illustrations of the advantages that accrue to empirical mechanics when illuminated by sound science.

(To be continued.)

IMPROVED FORM OF RAIL LIFTER.

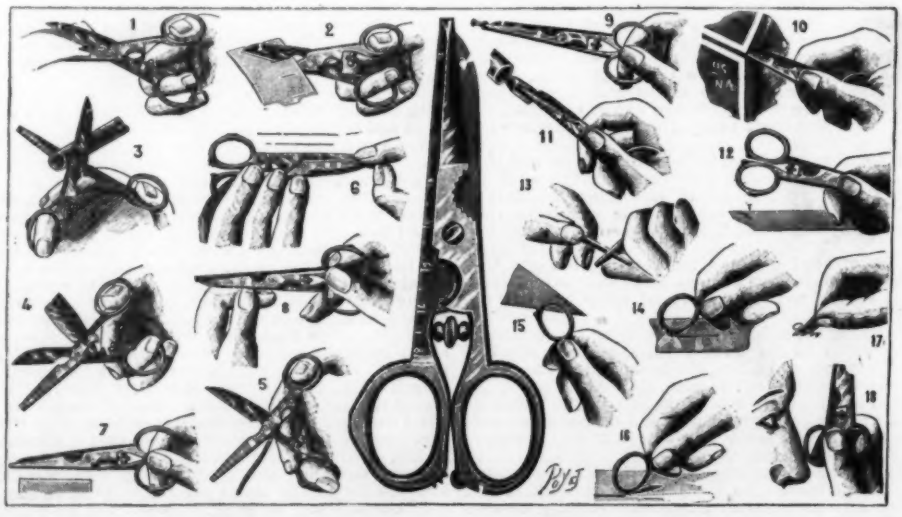
WE illustrate herewith a type of rail lifter of Continental origin which is now being introduced into this country by Mr. Paul Rothermel, of 105 Leadenhall Street, E. C. The general appearance of the tool is well shown in Fig. 1, which, with the section, Fig. 2, shows clearly all details of the construction. The tool is essentially a pair of compound levers, one of which is supported on a fixed fulcrum, and is applied at one end direct to the rail, while the other end is depressed by a second lever, the fulcrum for which can be supported in any pair of the sets of *u* notches shown. In commencing work this second lever is supported in the upper pair of notches, and as the work proceeds is shifted in succession to the lower pairs. During the transfer the rail is prevented from springing back by the arrangement shown in the cross section. A stop pivoted on the lifting lever, as shown, bears against a locking lever pivoted below. Behind this locking lever is a follower-piece, which slides in the segmental slots shown. It will be seen that the back of the locking lever is out of center with the fulcrum of the lifting lever, and hence, the latter having been forced down cannot fly back when the pressure is taken off, as the follower piece sliding down in its slots takes up all slack and keeps the locking lever in close contact with its stop. To raise the lifting lever again, it is only necessary to lift this follower piece, thus allowing the locker lever to move back. For lifting the tool from place to place a convenient handle is provided.—Engineering.

IMPROVED FORM OF RAIL LIFTER.

COMBINATION SCISSORS.

THE accompanying engraving, reproduced from La Nature, represents a pair of scissors which may be used for eighteen different purposes. The lower blade, situated to the left in the figure, is provided with a cutting edge at the upper part and a small aperture to the left. The handle is slightly flattened upon the left side and carries a small toothed wheel near the base. The other blade is provided upon the left side with a straight edge divided into centimeters, while its handle carries a solid steel roller, and presents a small aperture to the right. Upon the right side of this blade there is a recess with a toothed edge.

The apparatus may, in the first place, be used as ordinary scissors, as shown in No. 1, and, in the second, for cutting button holes, as shown in No. 2. The toothed recess in the center permits the apparatus to be used as a pipe wrench (No. 3). Below the central pivot there are two incurved cutting edges which move upon one another and may be used as a cigar cutter (No. 4). Just above this there are two small sharp-edged apertures that may be used for cutting wire (No.



COMBINATION SCISSORS.

5). If it be desired to draw a series of parallel lines, it will suffice to place the straight-edge in the position shown in No. 6. As this same edge is divided into centimeters, it may be used as a rule to measure various small objects (No. 7). Upon the side of the first blade is arranged a file for the finger nails (No. 8).

The extremity of the scissors is beveled off on each side, so that it may be used as a screw driver (No. 9), or as a chisel for prying open a box (No. 10). By means of the aperture to the right in the first blade a cartridge may be withdrawn from a weapon (No. 11). The flattened part of the handle to the left may be used as a tack hammer (No. 12).

Upon removing the rivet so as to disconnect the two blades, the latter may be employed for the following purposes. The right blade may be used as a knife for sharpening a lead pencil (No. 13), while the wheel at the base may be employed for cutting a pane of glass (No. 14) and the notch at the side for breaking it (No. 15). If it be desired to draw dotted lines upon paper, the operation may be performed with the toothed wheel in the handle to the left (No. 16). The extremity of one of the blades serves also as an eraser (No. 17).

Finally, when the blades are in place, the scissors may, according to the manufacturer, be used as a stereoscope (No. 18). This, at first sight, would seem to be a little problematical.

ELECTRIC CARRIAGES AT THE EXPOSITION OF THE AUTOMOBILE CLUB.—No. II.

HAVING described the phaetons exhibited at the Exposition of the Automobile Club, it now remains for us to speak of some of the principal automobile carriages shown.

The Darracq Carriage (Leon Bollée arrangement).—MM. Darracq & Company exhibited at their stand five or six elegant carriages which the visitors never became tired of admiring. The Darracq carriage (Fig. 1) stands midway between the phaeton and the large automobile. It has all the easy-riding qualities looked for by the amateur in automatic propulsion, without any of the accompanying inconveniences; while its mechanism is so simple that anyone can set it in operation without much instruction. The motor, which is placed in front, and is cooled by flanges, offers a very great resemblance to the small Bollée phaeton, with which everyone is familiar. It is of 5½ or 6 horse power, and thus enables the carriage to climb any hill. All its regulating parts are within easy reach of the driver. The changes of speed are effected through the shifting of a single belt, by means of a special triangular fork, over a series of steps formed by two inverted cones. This belt shifter is operated by a handwheel and is capable of taking five different positions, corresponding to five changes of speed. To the left of the driver is the driving lever, which acts upon a special cone pulley placed at the back of the

FIG. 5.—THE VEDOVELLI & PRIESTLEY CARRIAGE.

pressure upon the pedals, a carriage running at a speed of 17 miles an hour may be stopped within a few yards. As for the steering mechanism, that is of exceptional simplicity and certainty. Finally, to the left of the driver and maneuvered from the seat, there is a belt stretcher by means of which the rear of the carriage is displaced to a maximum of three inches, thus assuring of any desired degree of tension being given to the belt.

Electric Carriage of the Compagnie Française des Voitures Automobiles.—Everybody is familiar with the old electric carriage of the Compagnie Française des Voitures Automobiles, which, in fact, is the type adopted and exploited by the Compagnie Générale des Voitures at Paris. In this carriage there was, from an æsthetic point of view, much to be desired, but this year the company shows us a vehicle in which comfort and elegance are combined. The motor, which has two collectors (thus forming in reality two motors), is placed in front of the driver and is vertical acting. It is capable of developing from 3½ to 10 horse power, and, at the lowest velocity, furnishes 35 amperes at 80 volts.

In front of the driver there is a small handwheel which acts upon the controller. By revolving this in a certain direction, every degree of speed is obtained—slow, accelerated, and rapid; while by revolving it in the contrary direction, a stoppage is effected, the electric brakes are applied, or the motion of the carriage is reversed. The motor and the controller are inclosed in a box, and are consequently completely

The motor revolves a vertical shaft, and, through a bronze gear wheel, communicates its motion to another and larger vertical shaft (to be seen in front of the carriage), while a Cardan joint permits the mechanism to withstand all shocks due to the inequalities of the roadway. The motion of this shaft is transmitted to the front axle through a bevel pinion. The differential gear and pinions are inclosed in a box placed at the center of the axle. In this way is obtained a driving and steering fore-carriage, which, as well known, possesses many advantages in automobile propulsion. As for the source of the electric energy (accumulators), that is concealed under the seats.

The Vedovelli & Priestley Electric Carriage.—The electric carriage exhibited by MM. Vedovelli & Priestley was one of the most original of the Salon (Fig. 5). A hansom capable of being converted into a vis-à-vis for four passengers, a small wheel in front and two wheels behind, and a driver's seat in the rear—such are its general features. The steering (which is by an entirely original method) is effected by utilizing the reversibility of the differential gear, that is to say, by acting upon the latter in order to cause one wheel to turn more quickly than the other. It is therefore the two hind wheels that do the steering. This arrangement has, on the one hand, the advantage of rendering it possible to turn the vehicle within a short radius, or even to cause it to pivot in situ, and, on the other, of not obliging the driver to revolve the steering handwheel in an opposite direction in order to go in a straight line at the end of a turn about. Each of the hind wheels is actuated by a special motor, the planet wheel of the differential gear (held immovable around the axle by a peculiar arrangement) being connected with the steering device. Within reach of the driver is placed the steering handwheel and also the controller lever that permits of reversing the motion of the carriage as well as of obtaining the changes of speed due to the coupling of the motors in tension or in quantity. There is one style of brake that acts upon the shaft of the differential gear and is maneuvered by the same lever as the controller, so that the brake cannot be applied without cutting off the current from the motors; and another style (actuated by a pedal) that breaks the current, which can be set up again only by bringing the controller lever to the position of stoppage. It will thus be seen that these two arrangements of brakes offer every security, since, after they have been applied, starting at full speed is rendered impossible. As for the accumulators, they are placed under the carriage in a special box and permit of making a run of from 42 to 48 miles. For a longer trip, the manufacturers place a portable charging apparatus upon the carriage. This consists of a small De Dion-Bouton gasoline motor of ¾ horse power, and of a small dynamo coupled upon the same shaft and giving 10 amperes at 110 volts, the whole inclosed in a case.

The accumulators are charged at the stopping places. A special device, acting upon the gasoline motor, stops the latter after the accumulators have been charged to saturation. This portable apparatus, which weighs but 308 pounds, may be used likewise for the supplying and lighting of fifteen 16-candle lamps. MM. Vedovelli & Priestley have thus suppressed the inconveniences of electric propulsion upon highways, due to accumulators. In their arrangement, only the quan-

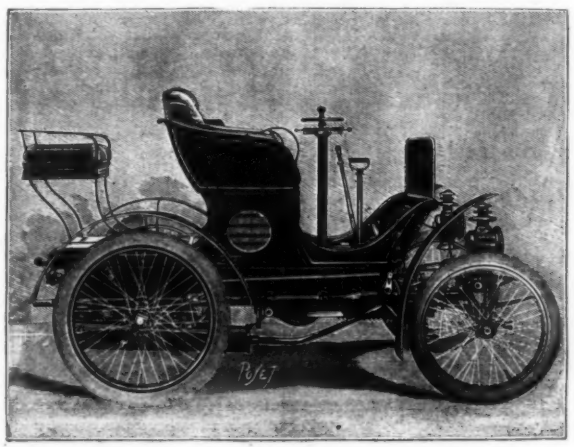


FIG. 1.—THE DARRACQ CARRIAGE.

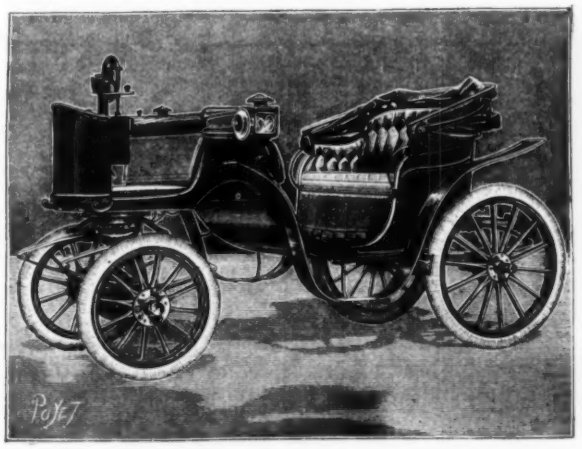


FIG. 2.—CARRIAGE OF THE COMPAGNIE DES ÉLECTROMOBILES.

FIG. 3.—THE RICHARD ELECTRIC AUTOMOBILE.

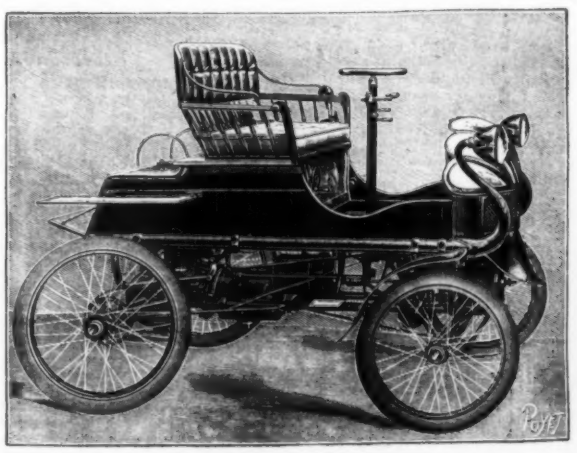


FIG. 4.—THE PIEPER CARRIAGE.

tity of gasoline necessary for the running of the vehicle is carried, just as if it were a question of an ordinary gasoline automobile.

The George Richard Electric Carriage.—The Richard establishment, which is known to everybody for the elegance of its gasoline carriages, has recently made a place for itself in the electric automobile industry. At its stand was exhibited a very elegant vehicle (Fig. 3) carrying the accumulators, to the number of forty-four, concealed under the seat. The accumulators employed are those of the Société des Accumulateurs Electriques.

A special motor communicates its motion to the hind wheels through the intermedium of chains. It is asserted that the consumption is but about 100 watt hours per mile. Within reach of the driver there is a steering hand wheel and a lever for regulating the running of the carriage. Upon moving this lever in one direction, three speeds varying from 3¼ and 6 to 12 miles per hour are obtained; while by moving it in the contrary direction, the motion of the vehicle is reversed. Under the driver's foot there is a brake pedal that permits of obtaining a very sudden stoppage. To the left there is a brake lever for acting upon the hind wheels.

The Pieper Carriage.—The Pieper establishment, of Liege, exhibited a peculiar carriage of a certain originality, run by both gasoline and electricity (Fig. 4).

At the front part of the vehicle is placed a gasoline motor of small power cooled by flanges. Between this motor and the gear connecting it with the hind wheels there is a dynamo which is capable of performing the part of an electric motor, and is connected with a small battery of accumulators. At the start, the gasoline motor is set in operation through the intermedium of the dynamo, requiring but a small portion of the energy from the battery of accumulators.

When the vehicle is upon a down grade or at a standstill, or, in a word, when there is no need of all the energy disposable by the gasoline motor, the latter immediately actuates the dynamo, and this charges the accumulators.

When, on the contrary, the carriage is going up hill, the dynamo immediately and automatically operates as a motor in taking power from the battery of accumulators; and its action is added to that of the gasoline motor. It is possible in this way to employ but two motors of small power and a battery of accumulators that may be very limited, since their respective effects may be added together.

On the other hand, in case of accident to the gasoline motor, it is possible easily to reach home by utilizing only the dynamo motor. It would be premature to express an opinion as to the future that may be in store for this new combination; and we shall have to wait until experience has taught us the true value of the arrangement. It is allowable to suppose, however, that the adjunction of electricity to gasoline may prove fruitful in results under certain circumstances. M. Pieper has applied to his carriage a principle that has already been utilized for the electric lighting of railroad cars: The revolution of the wheels sets a dynamo in motion, and some accumulators are charged and supply the lamps. Here it is a little different, although the idea is the same. The entire excess of power disposable is utilized, and the arrangement restores it at the proper moment.

For the above particulars and the illustrations we are indebted to La Nature.

ELECTROTYPING AND ELECTRO-PLATING DYNAMOS.

THE columns of The Electrical Engineer, of London, have recently been given up to a discussion of what type of dynamo is desirable for general electrotyping and plating work? What voltage should it be designed to give? Three answers are given by different contributors. 1. The chief requirements of dynamos for electro-plating and typing are: (1) Low E.M.F. generated; (2) low internal resistance; (3) the field magnet poles must not be liable to reversal by the back E.M.F. of the bath. Low voltage is required owing to the low resistance of the bath through which it is to drive the current, the approximate volts required for depositing various metals to the best advantage being as follows: Copper (sulphate solution), 1 volt; copper (cyanide solution), 5 volts; silver (cyanide solution), 1·5 volts; gold (cyanide solution), 1 to 3 volts; nickel (sulphate solution), 1 volt. A plating dynamo, if it is likely to be required for more than one process, should therefore be arranged in such a way that the voltage may be easily altered, the most convenient method being by the ordinary rheostat in the shunt circuit. As the E.M.F. of a dynamo depends on its speed, its magnetic flux or strength of field, and the number of conductors in series round the armature (no matter how many poles there may be), one or more of these quantities must be made very small in order to obtain the low voltage required. If the speed is very low, the machine must be abnormally large and heavy for its output; if the field is too weak, sparking is bound to occur; while if the number of conductors is diminished below a certain point, unsteadiness and sparking will again cause trouble. It is usual to make all three as small as possible, compatible with general efficiency and economy. The internal resistance of the dynamo must be small, owing to the large currents usually required (the amount of metal deposited being proportional to the current) and the low voltage. In order to obtain this low resistance and high carrying capacity, the conductors (if single) on the armature must be of large cross section. But if wires or bars of great section are used, they will become overheated from eddy currents generated in their mass, and for that reason stranded, stranded and compressed, or, better, a number of smaller insulated wires in parallel should be used, the paralleling being performed by means of wide brushes on the commutator.

Coming now to the third requirement of a plating dynamo—viz., a non-reversible field—there are three chief ways of obtaining this: (*a*) the magnets may be separately excited; (*b*) a series winding may be used with an automatic cut-out, which will open the circuit when the current, in reversing, reaches zero, or before it has obtained any magnitude in the opposite direction; (*c*) the magnets may be shunt wound. In (*a*) a separate dynamo is required for exciting, and the consequent expense forbids its use to any great extent; in (*b*) the automatic cut-out is also an extra expense, and is not as a rule absolutely reliable. This leaves only case (*c*) to be considered, and in nearly all cases this is the method adopted. There is a good deal of obscurity among budding (very) engineers as to why the back E. M. F. of accumulators, electrolytic baths, etc., when it overcomes the E.M.F. of the dynamo, does not send a pole-reversing current through the shunt winding. The two sketches (Figs. 1 and 2) may therefore not be out of place here. In Fig. 1 the arrows show the direction of the current from the dynamo, while in Fig. 2 the back E.M.F. of the bath has overcome the forward E.M.F. and caused a current, also indicated by arrows, back through the dynamo. It will be seen that the current through the shunt is the same in both cases, and therefore the polarity is not reversed. This is in every way the best method of guarding against pole reversal, it being the most economical and the most certain.

As regards the field magnets, they are usually multipolar except for small machines, the chief reason being that the sparking limit of a dynamo is governed by the number of amperes circulating in the armature per pole—not by the maximum ampere turns of the armature—and with the large currents generated in plating machines, it is difficult to keep inside the sparking limit with only two poles. Four and six pole machines are the most generally used, although there are a large number of two-pole machines of large capacity also working satisfactorily. Another advantage of the multipolar type is that the armature conductors need only be large enough to take a fraction of the current they carry in a two-pole machine, according to the number of poles. In a four-pole machine they take only one-fourth of the total current; in a six-pole machine one-sixth of the current, and so on.

The general type of dynamo for electroplating, etc., should, therefore, be a shunt-wound multipolar type, with drum-wound (preferably) armature, having two

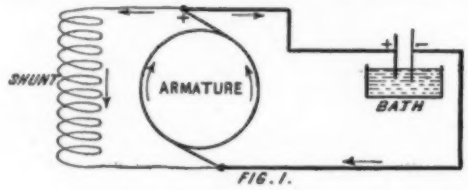


FIG. 1.

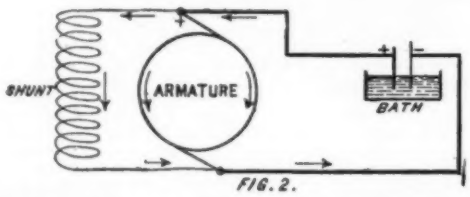


FIG. 2.

or more consecutive insulated conductors put in parallel on the commutator by means of thick brushes. The number of conductors or sets of paralleled conductors on the armature should be as small as possible without causing fluctuations and sparking, and the speed should be as low as is compatible with economy. It should be noted that when a number of baths are required to be worked in series, the E.M.F. of the dynamo must be greater, according to the number of baths in series and the volts required by each. In this case the difficulties in the way of design are much less than when a very low voltage is required.

2. The chief requirements in a plating dynamo are: (1) non-reversibility of the machine by the back voltage of the vats—this is secured by making the machine shunt-wound or separately exciting it; (2) complete control by the attendant of the voltage of the machine, so that any desired strength of current through the bath can be obtained, and also that varying numbers of vats can be in use at once.

All well designed modern dynamos, for voltages up to at least 100, allow variations of terminal voltage from the full value to practically zero with any current up to the full rated amount, to be obtained by the combined use of a shunt-regulating resistance and a certain amount of forward shifting of the brushes. The field strength is first reduced until there is only a slight margin between the armature ampere-turns and the field ampere-turns, and then sufficient forward lead is given to the brushes to give the desired voltage. This is found perfectly feasible, using only ordinary copper gauze brushes, and without any sign of sparking. As to the general design, the armature should be of the slotted type, so that the heavy conductors may be embedded in the iron, and prevent the occurrence of eddy currents. Smooth-cored armatures with conductors occupying a large angular breadth on the periphery, even when these conductors are made of twisted stranded cable, or of a number of separate parallel wires, generally give trouble by heating due to eddy currents. The maximum voltage for which the machine should be wound depends on the quantity of work to be done—i. e., on the number of vats in use. For small machines up to say 10 h. p., the current should be kept under 1,000 amperes, as larger currents cause losses in friction and resistance of contact at the commutator quite out of proportion to the useful output. At the same time the expensive commutator and brush gear required for the larger currents greatly increase the price of the machine. A current of about 500 amperes (386·4 amperes theoretically) will deposit 1 pound of copper per hour in each vat, or will cover an area of one square foot with a deposit 0·02 inch thick in each vat. On this basis the maximum number of vats likely to be required should be determined, and an allowance of about two volts per vat, together with an additional volt or two for loss in leads and connections, should be made. For general work in a single vat a dynamo wound for from three to five volts is the ordinary requirement.

3. From every point of view a shunt-wound dynamo is the type to be used for electrotyping and plating work. The disadvantage of using a series machine is evident. In plating, the voltage of the plating dynamo is opposed by the back E.M.F. of the baths, and the current in the circuit is proportional to the difference of these E.M.F.'s divided by the total resistance of the circuit. This state of affairs continues as long as the dynamo E.M.F. is greater than the back E.M.F. of the baths, but if from any cause the dynamo E.M.F. becomes less than the formerly opposing E.M.F., the current in the circuit changes its direction. This has the effect of reversing the dynamo field, and so reversing its polarity and its direction, for it will now run as a motor. The two E.M.F.'s are now acting in the same direction, and will send a very large current through the circuit, which, moreover, will be going through the baths in the wrong direction. These are the main objections to a series-wound machine. A compound-wound machine is not advantageous, because it is not always desirable to have the voltage constant, if the dynamo is for general work. Moreover, difficulty might arise from the series coils weakening the field, as in a series machine. A shunt machine is perfectly safe, and cannot by any possibility be reversed. For even if the dynamo E.M.F. becomes less than the cell E.M.F., and so causes the current in the main circuit to reverse, the current in the shunt coils will not be reversed, as will be plain from a consideration of the connections of the machine. The dynamo will run as a motor, but in the same direction as formerly, because its armature current is reversed while the field continues as before. As its direction is unchanged, its back E.M.F. as a motor will be in the same direction as formerly, when it ran as a dynamo, and hence the total E.M.F. of the circuit will still be the difference of two E.M.F.'s not far different in size. The current will not rise to a dangerous extent, although it is in the wrong direction through the bath. This cannot be avoided, but evidently a shunt machine is best suited to minimize it.

As different kinds of plating work require different voltages, it will be necessary to arrange the dynamo to suit this. It may be possible that the range may be small enough to allow of the alteration taking place by means of resistance in series with the field only. But if the requirements are more than can be used thus, it is usual to insert resistance in series with the main circuit, or, if the baths have a very low back E. M.F., to put two or more of them in series.

Hence a shunt machine can be made to fulfill all the requirements of general plating work. As to the voltage for which this machine is to be wound, while special cases require special treatment, a useful voltage for ordinary work is from eight to ten volts. If no nickel plating is to be done, then six volts would be sufficient. The following table, taken from S. P. Thompson's "Dynamo Electric Machinery," will show the variations necessary:

PRESSURE AT TERMINALS REQUIRED FOR DIFFERENT KINDS OF BATHS (IN VOLTS).

Copper (acid bath)	0·5 to 1·5
" (cyanide bath)	3 " 5
Silver	0·5 " 1
Gold	0·5 " 4
Brass	3 " 5
Iron (steel facing)	1 " 1·3
Nickel on iron, steel, copper, with nickel anode, strike deposit with five volts, diminishing to	1·5 " 2
Nickel on iron, steel, copper, with carbon anode	2 " 4
Nickel on zinc	4 " 7
Platinum	5 " 6

The above list will give a fair idea of the range of volts which will be required for the work, and, this being settled, it will be easy to wind the machine to suit.

ELECTRIC RAILWAY CONSTRUCTION IN GERMANY.

OF the more important German cities, Aix la Chapelle, Brunswick, Chemnitz, Dresden, Hamburg, Hanover, Leipzig, Munich and Stettin have almost completely abandoned horse cars and are supplied with electric roads. In the cities of Berlin, Breslau, Cassel, Cologne, Frankfort-on-the-Main, Düsseldorf, Barmen, Elberfeld, Königsberg (East Prussia), and other places, horse lines are being converted into electric roads, and most of these have suburban electric roads completed. A large number of electric lines are being constructed in the country districts about Aix la Chapelle, Bochum, Gelsenkirchen, Düsseldorf, Vohwinkel, Elberfeld, Barmen, Elbthal, Essen, Krais Hoerde, Reisengebirge, Waldenburg (Silesia), Witten-Ruhr, and in the mining districts of the Saar (southern Rheinland) and in Upper Silesia. In thirty-five cities and districts, not mentioned in the above lists, electric roads were in the course of construction on September 1 last, in nine of which the roads were completed and put into operation before the close of the year; so that at the beginning of the year 1899, there were seventy-seven cities and districts in the empire supplied with electric roads. In thirty-five of these places, extensions were being made to the lines in operation September 1, 1898, some of which were completed before January 1.

The following is a comparative statement of electric railway contruction in Germany for the past three years:

Description.	August, 1896.	September 1, 1897.	September 1, 1898.	Per cent. of increase in 1898 over 1897.
Power houses	42	56	68	21·4
Miles of roads	362·2	594·7	888 1	21·4
Miles of tracks	530 7	842·1	1,204·9	43
Motor cars	1,571	2,255	3,190	41 5
Trailers	580	1,601	2,128	32 9
Electric power, "K.W."	18,560	24,920	33,843	33 8

Adding the roads put in operation since January 1, 1899, it is estimated that there are now 930 miles of electric roads, with a total of 1,300 miles of tracks, in Germany. Many American cars are used.

From the city of Düsseldorf there are now four subur[illegible]ric lines completed: From Düsseldorf to [illegible], about 12 miles; from Düsseld[illegible] to Rattigen, about 8 miles; from Düsseldorf to Benrath, about 6 miles; and from Düsseldorf to Kaiserswerth, about 5 miles. GEORGE P. PETTIT, Consul.

Düsseldorf, April 6, 1899.

A THEORY OF SLEEP.*

SLEEP is not peculiar to man, for it presents itself in every organism. "Protozoa themselves sleep," says Milne Edwards, and sleep must therefore have quite a general cause. Some substances (narcotics, anaesthetics) provoke sleep either by dehydration or by producing congestion in the nervous centers, etc. On the other hand, sleep does not invade every organ in the same manner; it presents itself sporadically in such organs as happen to be extremely tired, or in those that are not well fed. It does not, in short, essentially differ from hibernal sleep.

Let us seek then for a philosophical explanation comprising every particular case and requiring no suppositions nor vitalistic theories. I find but one entirely general cause: the delay of the protoplasmic currents in which life consists, as I stated in a special paper on this subject.†

THE SLEEP OF PLANTS.

In animals sleep is characterized by the flaccidity of their locomotor organs, while leaves remain in their nocturnal state on account of a very remarkable rigidity that seizes them. Linnaeus once received from Prof. Sauvageau, of Montpellier, a shoot of Lotus ornithopodioides L., which began to flourish in a hothouse at the garden of Upsala. The great botanist examined the flowers directly they opened and observed that they disappeared on the same night. He believed at first that they had been thoughtlessly cut away, but had to acknowledge his mistake next day, as the disappearance of the flowers at night depends completely on the close approach of the adjoining leaves, which form a kind of shelter for them. This observation afforded cause for fresh investigations, and it was discovered that every species of plants opens and shuts itself at an appointed hour, etc.

Explanation.—"The motor dilatation occurring in some leaves at the base of the petiole is due to two antagonistic factors, the one tending to raise the leaf, the other trying to bend it, but the former, being by nature the weakest, acquires an additional force whenever light and heat, endowed with a certain degree of intensity, produce an abundance of sap in the cells, which increases the turgescence: it can then resist the action of the opposite factor." In short, this is but a mechanical effect of the delay of the nutritive currents coming up the leaves.

DREAMS.

These vary both in essence and degree according to the state of the dreamer's circulation. Some hygienic exercise or the repetition of a lesson may probably cause certain neurons to go on moving during sleep. But when they have worked too actively in the course of the day they are liable to be utterly drained and exhausted when night comes, and when such is the case there may be dreaming of the facts that brought their fatigue about. An assiduous exercise of the neurons may facilitate their continuous development and action (e. g. in the student dreaming about his examinations again and again). Contrariwise, the absence of new impressions, or a limited exercise during the day, will allow the uniform rest of all the neurons and a thorough absence of nightmare (husbandmen).

Fixed ideas lead to madness, perhaps on account of an atrophy of the inactive parts, some limited congestions, hypertrophies, etc. This is no business of mine, but I must state that the possibility of the functions of some cerebral centers being accomplished independently is made manifest during sleep. This means that certain neurons become associated in an abnormal way, extending themselves too much, and that diseases of mind, disordered neuroplasmic vibrations, are not inhibited by the more powerful vibrations of sound judgment, this being then peacefully slumbering.

CAUSES OF SLEEP.

Theories on this subject are by no means wanting, but they concern man only; they are not capable of general application, and leave the innermost mechanism of the phenomena unexplained. I admit, if necessary, the action of poisons and that of the secretions of the organism accumulated during the day, but chloroform and hypnotism work in the same manner. Whether the brain be congested or whether it be anaemic, its functions are deeply modified on account of the delay of the currents. Moreover, the lowest animals (Protozoa) sleep and wake in accordance with the conditions of their activity.

I believe, therefore, that sleep originates, either in man or infusorian, in a delay or slowing of the protoplasmic or neuroplasmic currents, due to refrigeration, lack of nutritive fluids, congestion or anaemia. Everything grows wearied. Everything bores and is bored. Both Bütschli's foam and my protoplasmic mass made by synthesis, cease from visible movement after a certain period of activity. Briefly, it is a mere question of provisions. When the oxidizable ferment is spent, when zymoses decrease, and almost all the material carried from the external to the internal medium is wasted, it is but natural that movements and currents become slower and slower. The organism is then said to be sleeping. And how many degrees there are from the simple yawn and somnolence to the drowsiness of a worn-out and fatigued traveler! But currents do not cease entirely—death is not the issue. The transport of materials is slowly continued from the digestive apparatus to the recesses of the organism, from the outside to the inside.

In wakening organisms oxidations increase little by little (just as in Bütschli's plasm when heated); the current is augmented (as in Herrera's plasm when it receives a slight addition of peptone); the reagents in the laboratory begin to bustle, the forge's reverberations swell, and the hymn of work grows louder and louder until it finally attains the pitch of thunder. Bear this in mind, that the act of waking is a slow one, having many degrees and shades. At the break of day our sleep is light, and we begin lazily to stir ourselves without even opening our eyes, while we remain fluctuating in a pleasant languor.

Keep this rule in mind; whenever there is a cause, be it y, z, or n, that modifies nutrition, sleep will increase in the exhausted convalescent, in the newly-delivered mother, in the child endowed with an exceedingly active circulation, in the inhabitant of the tropics whose salts and water are perpetually drained by the everlasting cupping-glass of climate, in the traveler, in the drunkard, in Bütschli's "artificial protoplasm," and in my own when seen under the microscope at their respective periods of activity and asthenia, in the glutton who ingests and absorbs large quantities of nutritive material, and in the youth who has provoked great waves of commotion which propagate themselves through vast nervous territories. On the contrary, old people and sedentary persons sleep both badly and scantily, as they stand in waiting for death.

I do not admit, O metaphysicians! the existence of any hard and fast line between sleep, this anaesthetic of life, and waking. I do not believe, O vitalists! that an organism can ever be either completely awake or completely asleep. There is always something living, one organ sleeping and another palpitating. A goose never happens to shut both its eyes at once. My own heart has at no time slept as my brain does; it hardly ever rests, poor perpetual sentinel! And you, O muscles? We yawn, wake and work too. There are some disinherited, beggared organs sleeping in ascetics. Yet, there is a weak and slow nutritive current even there.

I deny, then, any hard and fast line; there are no barriers between sleeping and waking, just as there are no absolutely separated and divided things in nature, whether stars or organisms.

But the day comes when both the currents and the general irrigation cease; my Amazon is dry and the pale brain can drink no more from the drained internal stream. True sleep comes then. Cadaverous decomposition is, however, accompanied with some slight currents which are neither protoplasmic nor co-ordinated.

ABOUT SOME PARTICULAR CASES.

(a) Trance.—This consists in the diminution of certain currents, and is a more limited sleep than that effected in normal conditions. Hypnotizers avail themselves of several means of fixing or inhibiting currents (compression of the eyes, staring, gazing at a brilliant object, or suggestion, that is, the inhibiting action of the will on some nervous currents of a particular sort).

(b) The sleep of nocturnal animals in the course of day is related to the action of light. In Mexico bats have been observed to issue from their dens during eclipses of the sun; gnats flutter in rooms during daytime as soon as all doors are shut so as to leave the apartment in the dark. Everyone has seen that owls close their eyelids whenever a vivid light strikes them.

(c) Muscular Relaxation During Sleep.—I believe that muscular contractions are due to certain changes in the volume of the protoplasmic alveoli. Rhumbler has demonstrated that such is the possible cause of mytosis, and that the rows of small alveoli, when these are partly emptied, diminish in volume and exercise a strong tension on the centrosomes. The dynamical influence of those changes being wanting when nerves are sleeping, and there are no waves nor modifications in the intra-alveolar pressure, it is clear that muscles must relax.

The same happens in several pathological cases under the influence of fatigue or of certain depressing emotions, etc. This means that I suppose nervous waves to provoke the passage of the alveolar enchylema into the protoplasm of the muscles either by the mechanical action of the shock or by an increase of hydrostatic pressure. I do not deny that the latter have the structure and elasticity required. It will be remembered that the muscular wave moves along the muscles of ants in such a way that it is observable under the microscope. This could not be the case in a homogeneous liquid.

(d) Naturalists faithful to the old school would find a remarkable "harmony" in the following fact:

According to Van Beneden, the intestinal worms of bats enter into a period of hibernal sleep at the same time as their hosts. That is to say that the deep protoplasmic currents are delayed both in the host and its parasite by lack of nourishment.

SUMMARY (CONCERNING EVERY LIVING THING).

Nutritive currents are endowed with a very great velocity in active life.

Nutritive currents (sap, blood, protoplasmic currents) are periodically delayed by the want of the reserves expended during the day, and the result is sleep.

The same currents may be less active during the day on account of inaction or of some other cause, and the result is somnolence. This may also be ascribed to nervous excitation.

Currents delayed by the constant action of cold—sleep in winter.

Currents delayed by an excess of external heat—sleep in summer.

Currents delayed or even utterly prevented by lack of moisture—latent life.

General co-ordinated currents definitely stopped by coagulation, poisoning, hemorrhages, asphyxia, etc.—death.

AN ARTIFICIAL SCHEMATIC ORGANISM.

The principal varieties of sleep, life, and activity may be illustrated by an organism which I have constructed. It can be modified and perfected in a thousand ways, and several may be brought into connection. It consists of a damp chamber bounded by walls of cement and gypsum, or a paste of carbonate of lead and linseed oil (skin) with efferent capillary tubes (excretory apparatus). Between the two glasses and the two partitions there are big drops of Bütschli's cytoplasm or "artificial protoplasm" and water. In the middle stands a digestive apparatus formed of thin caoutchouc or of a snake's lung; two tubes of glass serve to keep it open at the ends, and it is made narrower in the middle; it receives food (peptone, water, and some sugar solutions) through one end and expels it through the other. For this purpose the mouth is covered after filling the cavity. The whole is afterward heated by means of a small oil lamp, and then cooled or dried, while the currents and the osmotic phenomena, the deposits, concretions, etc., are observed. The internal currents and movements are stimulated or paralyzed according to the conditions mimicking those called vital. As respiration cannot be imitated, the heat afforded by oxidations may be replaced by that furnished by the small oil lamp; after all it is exactly the same thing. The two glasses being difficult to unite, they may be replaced by Vierordt's glass box or hæmato-chrometer.

*By Prof. A. L. Herrera, in Natural Science.

†"Protoplasmic Currents and Vital Force," Natural Science, April, 1899

OVER-EXERCISE.

INTERFERENCE with digestion is a by no means uncommon effect of excessive exercise, and so far as training is concerned, it is one of the most destructive. The blood cannot flow in full stream to every part at once. As Dr. Brunton says, "Every one knows that while moderate exercise tends to produce appetite, a long and exhausting exertion tends to destroy the appetite, and even to produce actual sickness, as one finds in mountain climbing." People differ greatly in this respect, but in some—great ponderous men, as they may seem—the digestion is so easily upset by muscular exercise that, although they may be giants for a momentary exertion, anything like sustained effort disturbs digestion and cuts at the very root of their nutrition. In many cases, however, the limit to exercise lies in diminished excretion. Unless the excretory organs are thoroughly efficient, the tissues become crowded with products which cannot be got rid of, the senses become dimmed, and effort becomes a mere automatism, in consequence of a self-poisoning by the products of muscular waste. Interference with digestion so lowers nutrition, while accumulation of waste products so poisons the system, that in either case further exertion becomes impossible—the very will to make it passes away. But it is different in regard to the heart. The heart, although strained, may yet be driven on to its own destruction. Every muscular effort not only demands from the heart an increased flow of blood, but also drives an increased quantity toward it. So long as the heart can pass this forward all is well, but when it fails, not merely is the circulation of the blood rendered imperfect, but serious damage is done to the heart itself. If when the heart was overdriven it merely struck, the enfeebled circulation would soon put a stop to further effort. The willing heart, however, taking at each beat a wider sweep, and driving into the vessels a larger quantity of blood, so meets the call that the athlete can struggle on, perhaps to win his race. But the strained heart suffers, the stretched muscle does not quite come back, the dilated cavity does not quite close at each contraction, and permanent mischief is set up. Thus it is that exercise, driven to the limit imposed by the heart, is over-exercise in the most serious sense of the word. If it is the heart that stops it, the chances are that it has already gone too far.—London Hospital.

EARTH EATING.

No collector of national dishes includes earth or clay among them, but this is a favorite "plat" with a good many millions of people up and down. Even in Europe they are not difficult to find, or were not fifty years ago. Tastes have changed a good deal since then, no doubt. But human beings do not readily give up a favorite dish, especially when it is cheap. If superior persons denounce it, they enjoy the treat on the sly. Probably the quarrymen of Kiffhausen no longer breakfast in public upon slices of bread "buttered" with fine clay, as Humboldt saw them; but we should be rather surprised to learn that thrifty souls among them do not follow the custom of their ancestors in private. Humboldt was reminded of that early experience upon the banks of the Amoor, where he saw Russian soldiers eating what they called "rock butter," a similar clay. Mr. Laing had the good fortune to observe the first appreciation of the delicacy, or almost, in one district of Sweden. Five years only before he made the "tour" so famous in our grandsires' time there was dearth in the country. The people had already begun to eat "bark bread," when a very poor woodman noticed some white stuff among the roots of a tree he felled. It looked so clean and nice that he carried home a basketful, mixed it with rye and bark, and baked it. The loaf proved to be excellent and no disagreeable consequences followed. So the woodman told his neighbors, and a rush set in. When the magistrates heard of this abnormal provender they forbade the use of it, of course; that would be the natural impulse of the superior person. But the peasantry were not to be persuaded or coerced into rejecting food which they knew by experience to be wholesome and nourishing. When Mr. Laing visited the district—it is called Degenfors—they were using the stuff both for soup and bread. Samples dispatched to Stockholm for analysis gave "finely pulverized flint and felspar, lime, clay, oxide of iron, and a residuum of some organic matter similar to animal, which yielded ammonia and an oil."

It is organic matter which contains the nourishment everywhere, no doubt, if nourishment there be. But that is not always the case, and earth eating seems to deserve more attention than has yet been paid to it, so far as our reading goes. Commonly it is dismissed as a degrading practice of savages. But German quarrymen, Swedes, even Russian soldiers, are not to be classed with savages. Nor are the potters of Scinde. Their work is fashionable at present, and they make money—that is, by the Indian standard. But among their weekly expenses an allowance must be made for the quantity of "chaniah" which their wives and children consume. "Chaniah" is a white unctuous earth used for glazing pottery. But, as a rule, of course, it is savages who affect this diet, alike useful and agreeable to their taste. Few understand, perhaps, how common it is. Instances might be found in every continent and every zone by anyone who looked into the matter thoroughly. We give a few which recur to mind. The Ainos are enthusiastic earth eaters. In the north of their island is a valley where alone the material can be dug, but it is carried to all parts. They boil it with the root of the wild lily; when a certain proportion of the clay has settled, the remainder is poured off and eaten like cream. Sir Spencer St. John reports that the Sea Dyaks always took a supply of red ocher on their piratical expeditions as a reserve in case stores should run short; "and we once found in some deserted Seribas praus many packets of a white oleaginous clay used for the same purpose." In Java little cakes of earth are sold in the market; women buy and eat them to preserve a slender shape. The treatment succeeds, for

they lose all appetite. Humboldt asserts that the Indians of Quito put earth and quartz sand into their drinking water; but this is not unusual, so far as the earth goes, at least. We have heard a Boer family complain that they could nowhere get good water when absent from their home on the banks of the Orange. The water of the Orange is a "purée" of mud, hence its name. The peoples of New Caledonia eat pieces of a friable stone, "Lapis ollaris." Messrs. Cloquet and Brischet, traveling in those islands, could get no food for three days. They came upon some green laminate talc, and ate five ounces each; their strength returned and they never felt any inconvenience. The Ottomac Indians of South America live exclusively on fish when they can get it. But during the season of floods there is no fishing, and they manage very comfortably with earth. Moreover, they find the diet so agreeable that during the rest of the year they eat a ball of clay for dessert. Evidently it agrees with them, for the Ottomacs are very tall and robust.—Pall Mall Gazette.

RECENT EXCAVATIONS OF THE UNIVERSITY OF PENNSYLVANIA AT NIPPUR.

By Prof. H. V. HILPRECHT.

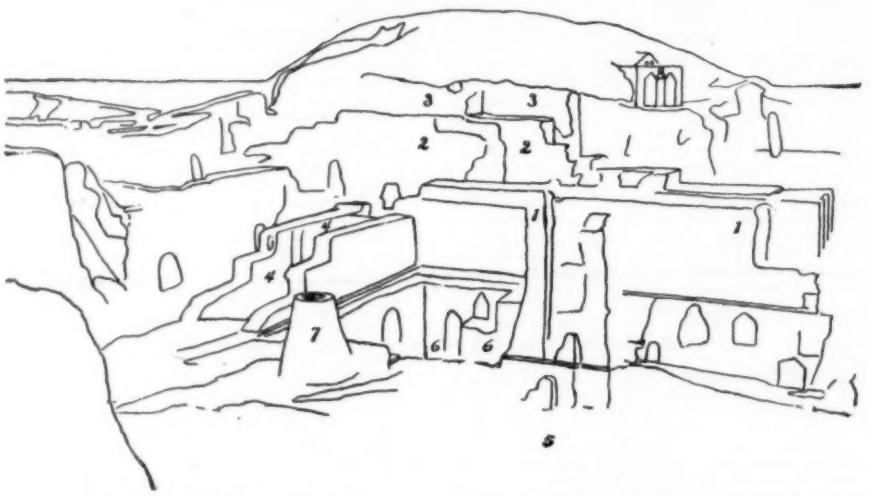
IN my last report, published in The Bulletin January, 1899, I gave a brief review of the history of our new expedition to Babylonia from the day when I left Philadelphia (May 19, 1898) for Constantinople, in order to secure a firman, to the time when the first members of the staff arrived at Nippur. A large number of Arab workmen having been engaged at Hillah, where all our tents, utensils and camp outfit had been stored for the last three years, it was decided to make the trip to Nippur by way of the Euphrates and the canal which connects the Affej swamps with the latter. In six sailing boats, later drawn by half-naked Arabs, Dr. Haynes and his party left for the ruins to be excavated, on February 1, arriving five days later at Nippur.

The Affej tribes, in whose territory the large mounds are situated, gave to the expedition a hearty welcome, accompanied by shooting, shouting, dancing and singing, evidently delighted to have the members of the expedition once more in their midst. Where formerly poverty and distrust of travelers and explorers ruled, a change had gradually taken place among the natives. In consequence of the comparatively great amount of money paid to Affej workmen in the trenches, and to their chief shaykhs for protection afforded to the party, and for milk, eggs, mutton, chickens and other provisions regularly furnished to our camp, the Arabs had learned to regard our work as extremely advantageous to their own interests. Also the hundreds of sick people, suffering principally from pulmonary diseases, typhoid and malarial fevers, who had received help and comfort from us in the past years, had been our best agents among their relatives and friends in the different tribes.

As ten years ago, when we went to Nippur the first time, Haji Tarfa was commander-in-chief of all the Affej, with his residence at Suq-el-Affej, a few miles to the southeast of Nippur. Surrounded by his minor shaykhs and other dignitaries of the El-Hamza tribes, he received our expedition-corps. The former arrangements with the two shaykhs, Hamid el-Birjud and Abud el-Hamid, were ratified and new pledges given for the security and welfare of our expedition, the supplying of guards and water (which had occasionally been stopped previously) being especially emphasized. Everything was soon arranged satisfactorily for the two contracting parties. Following the general Oriental custom, and desiring to show appreciation for the care with which the Arabs, during our absence, had guarded the expedition's stronghold—a mud castle erected on the plain half way between the ruins and the marshes—the members of the expedition prepared for their Affej hosts a great feast, at which plenty of mutton, boiled rice and thin barley cakes were eaten by some fifty Arabs. The old bond of friendship was thus cemented anew with "bread and salt."

According to the latest news received, which is dated April 8, the general health of the camp is good. But the activity on the field was greatly interfered with during the past months by the serious illness of Mr. Geere, one of the architects, who contracted pleuro-pneumonia and typhoid fever in rapid succession immediately after his arrival in Bagdad, December, 1898. He had to be left in "the glorious city of the caliphs," where he could have medical attendance and a certain amount of comfort. During all his illness and convalescence, which lasted over three months, he was nursed by the other architect, Mr. Fisher, of Philadelphia, a graduate of the Department of Architecture at the University of Pennsylvania. They have not yet arrived at Nippur.

THE MOUND AT NIPPUR.



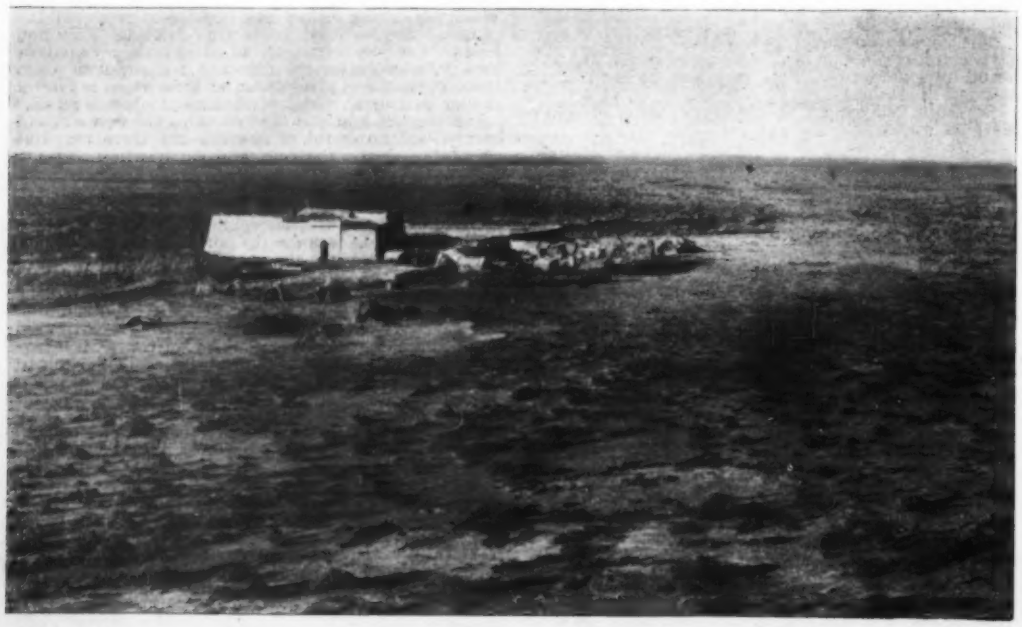
1, 2, 3. Three stages of the ziggurat. 1. East corner of King Ur-Gur's ziggurat (c. 2800 B. C.) 4. Entrance of the temple. 5. Platform of large baked brick, built by Sargon I and his son Naram-Sin (c 3800 B. C.) 6. Excavations of the lowest strata of the temple mound. 7. Water drain. 8. Modern building erected in 1894 for the members of the expedition.

OUTLINE SKETCH OF THE MOUND AT NIPPUR.

The actual excavations were begun on February 6, and were carried on in accordance with advices from the Philadelphia committee. Mr. E. W. Clark, chairman of the committee, who had eagerly watched and studied our past results, offered valuable suggestions. The present writer, acting as scientific director, was requested to prepare plans for the new campaign on the basis of his technical knowledge of the contents of the cuneiform inscriptions and the other finds, and his personal experience in the field. Following the instructions received from us, Mr. Haynes began to cut deep trenches into the southeastern mounds on the west side of the canal which divides Nippur into two nearly equal parts.

The results obtained during the first eight weeks of the excavation have fully realized our expectations. A long wall of an apparently important and very ancient structure, built of kiln-burned bricks, has been discovered and traced a distance of nearly five hundred feet, by a series of open trenches and tunnels at a considerable depth. The precise character of this wall and what it inclosed cannot be fixed, until I have received the technical report from the architects and squeezes of the inscriptions found in its neighborhood. On the level of the plain, twenty-three feet below the surface of the mounds, another arch of burned brick and part of a water course were excavated. One hundred and ninety-five tombs have been opened and examined. All the bones and skulls which allow of transportation were saved. Of the sarcophagi only such specimens will be removed as form an important link in the history of Babylonian burial customs, and which are valuable from an archæological standpoint, both the Imperial Ottoman Museum and our own University Museum having been supplied with the most representative types from the results of our last campaign. A large number of vases, many nose, ear, finger rings, anklets, bangles, bracelets, beads, etc., of silver, copper and stone were found in the tombs. A jar was discovered which contained miscellaneous coins and articles of jewelry, all belonging to the latest period of Babylonian history. Of special value are ten bronze cups, bowls and mirrors, some of them of beautiful form and fine workmanship.

The most important find, however, form the rescued cuneiform tablets and other inscribed objects. Nearly fifteen hundred tablets and large fragments have so far been taken out of these newly opened trenches. Apparently we have found another archive in the lower strata at a considerable depth below the present level of the plain. A large lump of earth, three and a half feet by one and a quarter feet, containing two layers of large unburned tablets, was brought in bulk to "the castle" to dry before they were extracted. Among the other remarkable objects which deserve notice today, seventeen sealed cylinders, seven inscribed steles of baked clay, and several fragments of a large burned clay cylinder may be mentioned. As stated above,



MUD CASTLE AND ENCAMPMENT OF THE NIPPUR EXPEDITION.

I have not yet received squeezes of these objects to determine their age from their contents and paleographical evidence. From general indications and past experience I am inclined to assign the bulk of the tablets and the inscribed steles to the period 2500–1800 B. C.

The number of workmen at present employed in the trenches is two hundred and eight. As soon as the two architects have arrived it is our intention to have the search for the city gates, so successfully begun, rigorously continued. A considerable gang of Affej will then be dispatched to the temple hill on the eastern side of the Shatt-en-Nil, to explore the lowest strata of the temple of Bel, which yielded the hundreds of small but important old Babylonian vase fragments, from which I was enabled to restore the importants texts of King Lugal-zaggisi and other powerful monarchs ruling in the fourth and fifth pre-Christian millenniums. I have no doubt that in the course of our excavations we will find a considerable number of other fragments of large statues in diorite, of which we have found portions of shoulders, noses, ears, clasped hands, and even the whole trunk of a human being, in two-thirds life size. They all belong to a period antedating 2800 B. C.

For the above article and photographs we are indebted to the Bulletin of the Free Museum of Science and Art.

ARAB HUT WITH HOUSEHOLD UTENSILS—MOUNDS OF NIPPUR IN THE REAR.

THE PAPYRUS PLANTS OF THE RIVER CYANE AT SYRACUSE.

THERE are few cities in Europe that have as distinct an individuality as Syracuse in the island of Sicily. It is probably the most interesting city in Sicily and one of the most interesting in Italy. A beautiful excursion from Syracuse is to the river Cyane, with its magnificent growth of papyrus plants. The boatmen first cross the great harbor to the mouth of the Anapus where the boatmen often have to jump into the water to help the boat over the sand bank. On a fine day, nothing can be more lovely than the beautiful flowers along the banks, which, combined with the transparent atmosphere recalls the scenery of the East, while from time to time Saracenic-looking buildings and palm trees are seen. About a mile from its mouth, the muddy Anapus is joined by the clear Cyane, to which reference is made so often by classical authors. Its narrow windings are often almost filled up by masses of the beautiful papyrus, the plant of the Nile, and a view of the tall and beautiful plants renders very real the story of the finding of Moses. The true papyrus grows nowhere else in Europe, and was possibly introduced from Egypt by the Syracusan rulers in the day of their intimate relations with the Ptolemies. As will be seen by reference to our illustration, the plants are exquisite in form and their color is very fine. The yellow plumes are supported on bright green stalks. They feather in masses far overhead, and boats seem to be lost in the thickets. The river is so choked by the aquatic plants, that the boats are propelled by the aid of poles, and even the men are obliged to jump out and push the boat along. At last the river seems to disappear altogether in the great thicket of green, and the boat is pushed into a broad blue pool of transparent water. Fifty feet below the fish can be seen swimming and the white sand at the bottom sparkling. This is the famous fountain of Cyane which is so much referred to by classical authors. According to tradition, the nymph who tried to arrest Pluto when he was carrying off Proserpine was changed by him into a fountain which covered the entrance to Hades. An animal festival was held by the Syracusans in honor of Proserpine, and some ruins not a great way from the fountain are pointed out as having belonged to the shrine of Cyane.

Of course, from a scientific point of view, the remarkable growth of the papyrus plant is the most interesting thing in the trip. The root of the papyrus is bulbous, sucking up moisture and nourishment by means of long thin fibers which attach it slightly to the sides and bottom of the river. From the separations of the bulb springs up the fine triangular rush of a bright green color to a height of eight or ten feet, and this is surmounted by a large tuft of the most delicate filaments, and near the end of each filament bursts forth the flower. Denon with some probability ascribes the introduction of this plant into the district of Syracuse to the intimate relations which existed between Hiero and others of its tyrants with the sovereigns of Egypt.

THE BIRTH RATE IN EUROPE.

SCIENTISTS and statisticians of France have been for some time occupied with the question of the decrease of the birth rate in that country. This naturally leads to the investigation of the birth rate of the other countries of Europe, in order to find out whether France is the only country going down in the scale. For this purpose the tables published by Signor Bodio, a prominent statistician of Italy, are of value; these tables have in fact been made the base of various investigations as to the movement of population. The order in which the countries of Europe are classed in decreasing series, according to their mean birth rate, is as follows:

1. Russia in Europe.
2. Hungary.
3. Servia.
4. Roumania.
5. Austria.
6. German Empire.
7. Italy.
8. Spain.
9. Finland.
10. Portugal.
11. Holland.
12. England and Wales.
13. Scotland.
14. Denmark.
15. Norway.
16. Belgium.
17. Sweden.
18. Switzerland.
19. Greece.
20. France.
21. Ireland.

Thus it appears Russia has the largest percentage of births and Ireland the smallest.

To find out whether in any of these countries the birth rate is on the increase or decrease, the figures for each for different years show that in all, except five, the movement of natality is on a decrease more or less rapid. M. Vauthier, analyzing the figures obtained by Signor Bodio, draws the following conclusion as to the diminution of the number of births:

The country of Europe in which the decrease is most striking is England, including Wales, whose coefficient of decrease is 0·306 per 100; Scotland, whose mean birth rate is nearly the same, decreases but 0·027 per 100; and Ireland, whose birth rate is much smaller, decreases only 0·0233 per 100. Somewhat after England and Scotland, but before Ireland, are found Holland and Germany, having a coefficient decrease of 0·0240 per 100, followed closely by Belgium (0·0239). Then, passing by Greece (0·0209), one reaches France, whose natality decreases annually by 0·0179 per 100. After France comes Russia (0·0158), Sweden (0·0147), Switzerland (0·0128). Last are found, having less than 0·01 per 100, Denmark (0·0078), Austria (0·0077), Pomerania (0·0033), and Hungary (0·0024).

The countries in which the birth rate is on the increase and in the order in which they are named are as follows: Italy, by 0·0083 per 100; Spain, by 0·0040; and lastly Servia and Norway, with coefficients of 0·0017 and 0·0012 per 100, being thus nearly stationary.—The Sanitarian.

THE SWORD OF THE PRAWN.

IN Knowledge for August, the Rev. Thomas R. R. Stebbing, F.R.S., continues his entertaining sketches of the members of the crustacean group. "When we turn to the prawns," says Mr. Stebbing, "we find many of them equipped in such a way as to put suppression of armaments out of the question. You cannot sheathe a sword that is an immovable projection from your own head. This part of a prawn's organization is called the rostrum. Its shape, its dimensions, the number and order of its teeth above and below, are seized upon by the naturalist for convenient specific characters. When they vary within the species, as they not unfrequently do, they become as specific characters very inconvenient. But all the prawn wants with them is that they should be characters inconvenient to his enemies. To fishes, such as are found sometimes with a small museum of fishhooks inside them, the sword of a prawn may make no difference. Such a fish will swallow the prawn, sword or no sword. But the fact that we cannot defend ourselves against earthquakes and thunderbolts is not a reason for exposing ourselves defenseless to a multitude of smaller mischiefs. Probably the serrate rostrum of the prawn is not intended for attack, so much as to ward off objectionable advances, and, in the last resort, to induce a disgust for an otherwise much appreciated flavor by lacerating the gullet and stomach of small sized aquatic epicures. The latter way of teaching them not to do it again must be expensive to both parties, and one may speculate whether it becomes efficacious by the extinction of the gourmands, or by some subtle spreading of experience throughout their tribe. In some prawns the rostrum is supplemented by another and a more dangerous looking weapon. The plate attached to the second joint of the second antennæ, which is often broad, and has the function of a float or balancer, is in Oplóphorus, the weapon carrier, transformed into a sharp pike. Unlike the rostrum, which is almost always immovable, this bayonet-like organ can be turned about to give the enemy an oblique or sideways thrust, an uncomfortable dig in the ribs, well qualified to teach a small fish to control in future an unchastened appetite."

Prof. Ewing, the English physicist, said in a recent lecture, according to The American Electrician, that a Chinese navigator named Hoang Ti so long ago as twenty-four centuries before Christ used a magnet for navigating a fleet of ships. "This, presumably, was the first use of the mariner's compass. The form in which he is said to have used it was that of a fragment of lodestone, which was floated so as to be free to revolve. Lodestone, it will be remembered, is a natural magnet, consisting of the natural magnetic oxides of iron. The mariner's compass of Chinese origin was first brought to Europe in the thirteenth century by a man named Marco Polo. Notwithstanding these early uses of the magnet, the science of magnetism will be only three hundred years old next year, as it dates from the publication of Gilbert's famous book in the year 1600."

THE PAPYRUS PLANTS OF THE RIVER CYANE, AT SYRACUSE.

TRADE NOTES AND RECEIPTS.

Fly Protective for Animals.—

Oil of cloves	3 parts.
Bay oil	5 "
Eucalyptus tincture	5 "
Alcohol	150 "
Water	200 "

Colorless Waterproof Coating.—A colorless waterproof coating is obtained by a mixture of tannic acid (tannine), 1 part; pure petroleum, 2 parts; turpentine, 3 parts; and hot water, 4 parts, well intermixed. The mixture is applied warm, and after the first coat is dry a light coating of pure hot linseed oil is put on. When this is hard, the articles may be used.—Farben Zeitung.

Weatherproof water-resisting stone is manufactured by a German firm, from sea mud, to which 5 per cent. of calcic hydrate is added, then the mass is dried, lixiviated, and dried once more at 100° C., whereupon the stones are burnt. By an admixture of crystallized iron sulphate the firmness of these stones is still increased. They are also claimed to possess special heat-isolating qualities.—Technische Berichte.

To Protect Wood Against the Constant Action of Moisture.—Wooden vessels containing continually aqueous liquids, as well as wooden shafts and other parts of machinery constantly exposed to dampness, will suffer in time if no protective coating is put on, a decomposition of the surface, which advances gradually to the interior and must finally destroy the article. In the Zeitschrift f0r Landwirthschaftliche Gewerbe, various receipts for protective coverings on wooden objects are given. For enameling vats, etc., 1 kilo. of brown shellac and 125 grammes of colophony are melted in a spacious kettle. After the mass has cooled somewhat, but is still thinly liquid, 6·1 of alcohol (90 per cent.) is gradually added. In order to prevent the ignition of the spirit vapor, the admixture of spirit is made at a distance from the stove. By this addition the shellac swells up into a semi-liquid mass, and a larger amount of enamel is obtained than by dissolving it cold. The enamel may be used for wood or iron.

The wood must be well dried; only then the enamel will penetrate into the pores. Two or three coats suffice to close up the pores of the wood thoroughly and to render the surface smooth and glossy. Each coating will harden perfectly in several hours. The covering endures a heat of 60° to 70° C. without injury. This glaze can also be mixed with earth colors. Drying quickly and being tasteless, its applications are manifold. Mixed with ocher, for instance, it gives an elegant and durable floor varnish, which may safely be washed off with weak soda solution. If it is not essential that the objects be provided with a smooth and glossy coating, only a preservation being aimed at, the following coat is recommended by the same source: Thin, soluble glass (water glass) as it is found in commerce, with about 24 per cent. of water, and paint the dry vessel rather hot with this solution. When this has been absorbed, repeat the application, allow to dry, and coat with a solution of about 1 part of sodium bicarbonate in 8 parts of water. In this coating silicic acid is separated by the carbonic acid of the bicarbonate; from the water glass (sodium silicate) absorbed by the pores of the wood, which, as it were, silicifies the wooden surfaces, rendering them resistive against the penetration of liquids. The advantages claimed for both processes are increased durability and facilitated cleaning.

Production of Lamp-Black.—The last oil obtained in the distillation of coal tar, and freed from naphthaline as far as possible, viz., soot oil, is burned in a special furnace for the production of various grades of lamp-black.

In this furnace is an iron plate, which must always be kept glowing; upon this plate the soot oil trickles through a small tube fixed above it. It is decomposed and the smoke (soot) rises into four chambers through small apertures.

When the quantity of oil destined for decomposition has been used up, the furnace is allowed to stand undisturbed for a few days, and only after this time has elapsed are the chambers opened by windows provided for that purpose. In the fourth chamber is the very finest lamp-black, which the lithographers use, and in the third the fine grade employed by manufacturers of printers' ink, while the first and second contain the coarser soot, which, well sifted, is sold as flame lamp-black.

From grade No. 1 the calcined lamp-black for paper makers is also produced. For preparing this black capsules of iron plate with closing lid are filled, the stuff is stamped firmly into them and the cover smeared up with fine loam. The capsules are next placed in a well drawing stove and calcined, whereby the empyreumatic oils evaporate and the remaining lamp-black becomes odorless. Allow the capsules to cool for a few days before opening them, as the soot dries very slowly, and easily ignites again as soon as air is admitted if the capsules are opened before. This is semi-calcined lamp-black.

For the purpose of preparing completely calcined lamp-black, the semi-calcined article is again jammed into fresh capsules, closing them up well and calcining thoroughly once more. After two days the capsules are opened containing the all-calcined lamp-black in compact pieces.

For the manufacture of coal soot another furnace is employed. Asphalt or pitch is burned in it with exclusion of air as far as practicable. It is thrown in through the doors, and the smoke escapes through the chimney to the soot chambers, 1, 2, 3, 4 and 5, assorting itself there.

When the amount of asphalt pitch destined for combustion has burned up completely, the furnace is left alone for several days without opening it. After this time has elapsed the outside doors are slowly opened and some air is admitted. Later on they can be opened altogether after one is satisfied that the soot has cooled completely. Chamber 4 contains the finest soot-black, destined for the manufacture of leather cloth and oil cloth. In the other chambers is fine and ordinary flame black, which is sifted and packed in suitable barrels. Calcined lamp-black may also be produced from it, the operation being the same as for oil-black. —Neueste Erfindungen und Erfahrungen.

MISCELLANEOUS NOTES.

Lloyds' last "Register of Shipping" gives the entire fleet of the world as 28,180 steamers and sailing vessels, with a total tonnage of 27,673,528, of which 39 per cent. are British. The Americans come next with 3,010 vessels, with a total tonnage of 2,465,387. Norway has 2,528 vessels, with a tonnage of only 1,694,230. Germany has 1,676 vessels, with a tonnage of 2,453,334, in which are included her particularly large ships. Sweden has 1,408 vessels, with 605,991 tonnage. Russia has 1,218 vessels, with a tonnage of 643,527. Italy has 1,150 vessels and France 1,182. Japan has 841, Denmark 796 and Spain 701.

M. L. Daniel distinguishes two stages in the anatomical processes which take place in grafting herbaceous or woody plants—the preliminary and the definitive stages. The former stage extends up to the moment when the functions of the outer and inner generating layers, interrupted by the operation of grafting, are resumed. The definitive stage may again be divided into two periods—the formation of the cellular tissues which fill up the vacancies caused by the wound, and the differentiation of the vessels and sieve tubes in the healing tissues produced by the activity of the inner generating layer and the formation of bark and phelloderm. —Bonnier's Rev. Gén. de Bqt., 11, 78.

The idea of the Geneva flag for ameliorating the condition of the sick and wounded in war, and rendering modern warfare less terrible, was due in the first place to the action of a doctor, a M. Dunant, who in 1859 stirred public opinion by publishing a realistic account of sights and scenes that he had witnessed on the battlefield of Solferino. M. Dunant was a citizen of Geneva, and a fellow-citizen, M. Moynier, a man of public note in Geneva, joining with him, the ball was set rolling which resulted eventually in the holding of the Geneva Convention. The Swiss national flag with the colors reversed was adopted as the Geneva hospital flag—a red cross and a white ground.—Army and Navy Journal.

In a recent article The Engineering Magazine pointed out that the American locomotive engineer deems it advisable to design his engine with a very large margin of power. If an express engine is designed to take a 200-ton load 50 miles an hour, and if that load should happen to be increased to 300 tons, the locomotive is still expected to be able to take it and keep time, and usually does so. Such, at any rate, is the experience of such an impartial and level-headed observer as Mr. W. M. Acworth. If an American express be late at one point of its journey, the engine is expected to make up the lost time, even if the load be larger than usual. And, again, this is generally done. But if an English engine is given a single coach above its prescribed load, the driver at once insists upon having a "pilot," and commonly he gets one.

The Russki Invalid states that the length of railways in Russia open for traffic on March 1 (13), 1899, amounted to 44,619 versts, or about 29,700 miles, but only to the extent of 8,098 versts were the lines double. Of the 44,619 versts, 2,430 are in Finland and 42,189 subject to the control of the Russian ministry of public ways. Of these latter 27,622 versts, of which 6,525 are double, belong to the state; 14,126 versts, including 1,483 double, belong to railway companies; and 441 are special. The lines in course of construction amounted to 9,141 versts, namely, 1,476 by the State Railway Board, 2,963 by the Siberian Railway Board, 295 Transcaspian by the war department, 4,374 by railway companies, and 33 special. Some of these lines are partly in use. In addition, the construction of 2,751 versts has been decided upon—178 by the State Railway Board, 2,491 by railway companies, and 82 special.

Some important observations concerning the action of the various gases upon caoutchouc and upon rubber tires have been made recently by M. d'Arsonval. If bits of caoutchouc tubing are placed in gaseous carbonic acid, under a pressure varying from 1 to 50 atmospheres, the substance increases considerably in volume and absorbs large quantities of the gas—so much so, that it often acquires ten or twelve times its original volume. At the same time, the caoutchouc becomes more gelatinous and less elastic. On leaving it exposed to the air, the carbonic acid disengages itself in bubbles, making a crisp sound on leaving, and in about an hour's time the caoutchouc has resumed its original aspect and properties. When carbonic acid is simply inclosed in a caoutchouc bag, it passes out rapidly through its walls. Oxygen does the same, though much more slowly. Here lies the explanation of the gradual deflating of pneumatic tires, says The Electrician. Newly-inflated tires deflate much more rapidly than those on which the pump has often been used, since the latter contain almost nothing but nitrogen, the oxygen having passed out through the tire without waiting for a puncture. The oxygen may be collected on the other side of a thin rubber partition. When tires are to remain inflated for a great length of time, they should be filled with nitrogen.

No. 455 of the Consular Reports, issued by the State Department, contains a list of the railroads of Switzerland, together with a list of the concessions for railroads which have been granted by the government and are now in force, the whole being a report made by Consul A. L. Frankenthal, of Berne. The length of railroad in Switzerland is 2,490 miles, divided as follows: Main lines, 1,943; narrow gage, 390; cogwheel lines, 56·5; cable lines, 11·8; street car lines, 88·9. The list shows the kind of motive power used on each of the 108 lines. The list of projected lines includes 120 companies with a projected length of 1,263 miles. On many of these it is planned to use electric motors. The names of the holders of the concessions are given, and where a line is in process of construction the fact is indicated in the list. It is said that this information has been gathered in response to a request made by American manufacturers and contractors. The procedure necessary to obtain a railroad concession in Switzerland is set forth in some detail, and appears to be quite easy to carry out. The consul believes that many concessions have been secured for speculative purposes. Concessions are granted for 80 years and no deposit is required. The conditions under which the government reserves the right to buy any railroad, after 1915, are briefly stated. The attitude of the government toward railroad building is very favorable.

SELECTED FORMULÆ.

To Distinguish Ivory.—To distinguish true ivory from the so-called vegetable ivory it is recommended (Apoth. Zeit.) to treat a sample for 12 to 15 minutes with concentrated sulphuric acid. Under these conditions true ivory retains its white appearance, while vegetable ivory from Phytelephus macrocarpa assumes a rose color, which may be removed by washing with water.—Druggist's Circular.

To preserve wire rope laid under ground, or under water, coat it with a mixture of mineral tar and fresh slaked lime in the proportion of one bushel of lime to one barrel of tar. The mixture is to be boiled, and the rope saturated with it while hot; sawdust is sometimes added to give the mixture body. Wire rope exposed to the weather is coated with raw linseed oil, or with a paint composed of equal parts of Spanish brown or lampblack with linseed oil.

Carbon Paper.—A workable substitute for the carbon manifolding paper bought in the stationery stores may be made as follows:

Lard	12 grammes.
Beeswax	2 "
Lampblack	2 "

Melt together the lard and wax, and pour gradually into a warm mortar, containing the lampblack, with constant trituration. Brush this mixture while still liquid over warm paper, and remove the excess with a flannel cloth.

Puncture Cement.—A recently patented preparation for the automatic repairing of punctures in bicycle tires consists of glycerine holding gelatinous silica or aluminum hydrate in suspension. Three volumes of glycerine are mixed with one volume of liquid water glass, and an acid is stirred in. The resulting jelly is diluted with three additional volumes of glycerine, and from 4 to 6 ounces of this fluid are placed in each tire. In case of puncture, the internal pressure of the air forces the fluid into the hole, which it closes.

Cement for Tires.—

Isinglass	½ ounce.
Gutta percha	½ "
Caoutchouc	1 "
Carbon bisulphide	4 "

Mix and dissolve.

Russet Shoe Paste.—

Yellow wax	1 ounce.
Palm oil	1 "
Oil turpentine	3 "
Oil mirbane	15 drops.

Make into a paste. The color may be heightened if not of the right shade by the judicious use of butter coloring made from annatto.

Russet Leather Shoe Polish.—

1.

Yellow beeswax	2 ounces.
Linseed oil	3 "
Oil of turpentine	10 "

Dissolve by means of a water bath in a closed vessel and add—

Hard yellow soap, finely shaved....1¼ ounces.

Dissolve the soap with the aid of heat in 14 ounces of water and add the solution to the solution of yellow wax and flaxseed oil formed in the first instance. A nice russet brown color may be imparted to this shoe polish by incorporating about 3 grains of Bismarck brown to each ounce of the polish.

2.

Oil of turpentine	10 ounces.
Yellow wax	5 "
Soap	½ "
Boiling water	10 "

Dissolve the wax in the turpentine by the aid of a water bath, and the soap in the boiling water. Mix and stir until cold and smooth.

3.

Soft soap	1 ounce.
Linseed oil, raw	1½ "
Annatto	4 "
Yellow wax	1½ "
Gum turpentine	4 "
Water	4 "

Dissolve the soap in the water and add the annatto. Melt the wax in the linseed oil and turpentine, and gradually add the soap solution, stirring until cold.

Bismuth Hair Dyes.—

1.—Chestnut.

Bismuth nitrate	230 grains.
Tartaric acid	75 grains.
Water	100 minims.

Dissolve the acid in the water, and to the solution add the bismuth nitrate and stir until dissolved. Pour the resulting solution into 1 pint of water and collect the magma on a filter. Remove all traces of acid from the magma by repeated washings with water; then dissolve it in:

Ammonia water	2 fluid drachms.

And add:

Glycerine	30 minims.
Sodium hyposulphite	75 grains.
Water, enough to make	4 fluid ounces.

2.—Brown.

Bismuth subnitrate	200 grains.
Water	2 fluid ounces.
Nitric acid sufficient to dissolve, or about	420 grains.

Use heat to effect solution. Also—

Tartaric acid	150 grains.
Sodium bicarbonate	168 "
Water	32 fluid ounces.

When effervescence of the latter has ceased, mix the cold liquids by pouring the latter into the former with constant stirring. Allow the precipitate to subside; transfer it to a filter or strainer, and wash with water until free from the sodium nitrate formed.—American Druggist.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Electric Industry in Japan.—Consul-General Gowey transmits from Yokohama, May 11, 1899, a clipping from The Japan Times containing interesting information relative to the electric industry in Japan, as follows:

Electroplating.—This branch of the electric industry dates back to about 1887, when a workshop was first started in Mita, Tokyo. For six or seven years the workshop had to contend against great odds, leading to repeated changes in its ownership. The outbreak of the Japan-China war did very much toward reviving the business. Subsequently, it experienced more or less vicissitudes incidental to the economic changes at large, but it may be said to have fairly taken root. Our electroplaters, however, are placed in a disadvantageous position in contrast to their Western confrères, the art being kept a secret in the West and there being no Japanese electricians who can teach them on this subject beyond broad theories contained in books, and even these not up to date. The consequence is that our artisans have no better alternative than to find out by dint of perseverance and repeated experiments and with imported samples before them the process they wish to discover. Taking all these things into consideration, the progress attained by our artisans is said to be quite creditable, especially since they have begun to use gas engines, for they are now enabled to turn out articles not much different in finish from those coming from abroad. There are at present some two hundred electroplating shops in the city, but of these there are only one or two where the business is carried on on a large scale, the others undertaking the work merely as jobs. Nickel plating is most in demand and more profitable compared with silver and gold. No definite information can be obtained as to the volume of yearly output of electroplated goods, though the demand is reported to have doubled during the five years ending 1897. Some shops in the same line appeared a few years ago in Osaka, and, like nearly all the industrial pursuits in that southern city, began, in competition with their Tokyo confrères, to turn out a cheap and inferior class of articles. The Osaka artisans have been beaten in this contest, so that at present Tokyo may practically be regarded as monopolizing the business in Japan.

Telephone Apparatus.—The manufacture of telephone apparatus has so far advanced in Japan that, with the exception of springs, for the supply of which foreign aid is still depended upon, all of the necessary paraphernalia can be made at home at about one-half the cost of foreign goods. At present, therefore, only a very small portion of telephone apparatus is being imported. Foreign instruments are used only in such places as Tokyo and Osaka, where the telephone connections are in brisk demand. Again, when the Communications Department is in need of a large supply for immediate use, it is obliged to patronize the foreign makers, it being not easy to procure the supply of Japanese instruments within a short time in any large quantity. The manufacture is carried on both at government and private shops, between which no particu lar difference is noticeable regarding workmanship. It is thought in some circles that, to encourage the development of the industry, the government shops ought to be closed and greater patronage accorded private enterprises. There are in Tokyo quite a number of such factories, of which only two or three are doing business on a large scale. There exist also a few in Osaka, as usual turning out a cheap and inferior quality.

Electromotors.—The electromotors made for the Kawasaki Electric Tramway at the Shibaura Engineering Works are the first of the kind made at home, those heretofore used by the Kyoto, Nagoya, and other tramway companies having been obtained from abroad. The Kawasaki Tramway is highly satisfied, we are told, with the Shibaura dynamos; for it has found them, so far as its experience goes, just as good as those of foreign make employed by other establishments. It is said that the Shibaura works have since secured orders to construct a number of the same apparatus for the Hoshu Electric Tramway Company. Of the materials required for their construction, the Shibaura works can obtain at home everything but wheels and springs, which have to be imported.

Failure of Crops in Southern Russia.—The failure of crops in many of the provinces of European Russia is a much more serious affair than is generally admitted. Nowhere has it been more complete than in the province of Cherson, which has within its borders the two largest exporting ports in the Russian empire—Odessa and Nicolaiev. During the famine year of 1891-92 this province suffered severely, though not as much as at present, says Consul T. E. Heenan, of Odessa. The famine year found the peasant farmers without any reserve stock of grain, and consequently without seed for future sowing or the means of subsistence until the next harvest. Their distress, however, had been provided for by the erection of storehouses in the peasant villages, in which every house owner had been obliged to place a certain quantity of grain for eventual public alimentation. Later on, the system was found to be inconvenient, and the grain was sold and the proceeds invested in interest-bearing bonds. Thus was formed the so-called "fund for the public alimentation." During the critical condition of affairs in 1891, the administrations of the districts purchased grain and distributed it to the peasants at cost price for food and sowing purposes, and a time was stipulated for the repayment of this relief.

This year, a conference has been called in this province (Cherson) to take measures to deal with the situation. The questions to be considered are the degree of failure in each district separately, the seed necessary for sowing the fields, the amount of government assistance which will be required during the year, and the amount of cash in the public alimentation and other funds at the disposal of the administrations for relief purposes. I am glad to be able to state that the amount of food supplies and funds on hand and available is quite large, amounting to more than 2,000,000 rubles ($1,028,000) at the present time. These funds will be applied to the purchase of grain for seed and also to the relief of distress. In addition to these funds, the province has another means at its disposal which will largely help to alleviate suffering. This is the organization of public works. A special fund has been kept in this province for the purpose of giving employment to peasants, under circumstances which the present year presents. The fund for the purpose is not large; still, it will be of service. The road-making fund will also be brought into requisition. Russian rural roads are perhaps the worst in the world, and Russian military roads the best.

A very important question to be solved is how the working stock and other animals are to be saved, the hay crop being a complete failure. Hay and fodder is now at such a price as to be beyond the reach of the peasant farmer. Horses and oxen are being sold far below their value, and evidences of great distress are visible, even at the beginning of summer. Stock raisers, who are among the more wealthy classes, are selling their stock for what they can get. It is not an easy task to sell, and the supply is constantly increasing.

Trade of Hong-Kong in 1898.—As Hong-Kong has no custom house, the only official source of information concerning imports and exports is the annual report of the harbor master, says United States Consul R. Wildman, of Hong-Kong. His report for the year ending December 31, 1898, has just been published, and it contains many items of interest to American exporters and shipowners who are interested in the commerce of Southern China and the Philippines. It will also be interesting to note the increase of American shipping in this port in 1898 over 1897. This has all taken place since August, within a period of four months. The increase for 1899 will be fully double that of 1898, because of the large number of ships plying between Manila and Hong-Kong that have gone under the American flag, and because of the greater consumption of American goods in Manila.

The total tonnage entering and clearing this port for the year 1898 amounted to 17,265,780 tons, an increase compared with 1897 of 1,327,606 tons. There arrived 39,815 vessels, aggregating 8,648,274 tons. Eleven steamers flying the American flag entered during 1898, as against 4 in 1897. Thirty-two sailing vessels came in under the American flag, as against 30 in 1897, America standing second to Great Britain, with 36 under the British flag.

The year 1898 was marked by heavy trade in rice and coal, and the introduction of oil from Langkat, Sumatra. The demand for rice was largely from Japan, and that for coal was a result of the late war with Spain and the centering of so many foreign fleets in this harbor. The American kerosene oil trade remained practically the same as in 1897. American flour shows a considerable increase in spite of the fact that from April to August the Manila market was practically closed to it. Hong-Kong imported from the United States 270,204 tons of cargo, as against 278,711 tons from the continent of Europe and 416,377 tons from Great Britain. The imports from the Philippine Islands amounted to 169,526 tons. The exports from Hong-Kong to the United States amounted to 148,525 tons, and to the Philippine Islands to 152,395 tons, leaving a balance of trade heavily in our favor. Among the imports in which the United States is interested are 103,544 tons of flour, 36,611 tons of cotton and cotton yarn, 55,160 tons of hemp, 67,362 tons of kerosene in bulk, and 59,115 tons of kerosene in case, all of which items except kerosene show an increase over 1897. There arrived during 1898, on vessels of all classes, 3,290,902 passengers. The total revenue of the harbor department, which is made up of light dues, licenses, and internal revenue and court and office fees, amounted to $183,628.01. These figures in some measure show Hong-Kong's importance in the shipping world. The peculiarity of the Hong-Kong trade is that the consumption of imports on the island itself is so small, as compared with the bulk of the trade, that it can be stated that almost all imports are again exported. Hong-Kong has often been called a vast bonded warehouse and clearing house for Southern China and the surrounding countries.

Petroleum Industry in Russia.—The St. Petersburg Messenger of Finance, in an article on the petroleum industry in Russia, states that English capitalists have recently invested $9,000,000 in the petroleum-producing territory between the Caspian and Black Seas, says Consul-General W. R. Holloway, of St. Petersburg.

Since 1892, when new regulations concerning the petroleum industry were published, more than thirty firms have received permits from the Minister of Agriculture and Crown Domains to engage in the petroleum industry in Russia, and applications are being made for permission to develop the petroleum-bearing territory on the Apsheron Peninsula, some 300 miles north of Baku on the Caspian Sea.

The increased demand for fuel caused foreign capitalists to look carefully after the residues, which has resulted in a decrease in the amount of kerosene exported and a greater demand for petroleum fuel at good prices; this increased 900 per cent. during the past six years and is still growing, notwithstanding the competition of pit coal and wood. The demand for petroleum fuel from the factories in and about Moscow has more than doubled in six years and now amounts to millions of tons annually.

The consumption of liquid fuel on locomotives has increased tenfold in nine years and on river steamboats fourfold in eleven years, while the consumption of coal increased 113 per cent. and of wood 58 per cent.

In order to meet the demand for liquid fuel, Baku must increase her output from 242,000,000 poods to 360,000,000 poods (3,903,226 tons to 5,806,451 tons); and in order to supply the increasing demand from the interior of Russia, it will be necessary to increase the output of residues to 8,064,516 tons in the near future. This development will require a further investment of $8,000,000, which must come from foreigners.

The slow development of the export of kerosene is explained by the fact that Baku finds it more profitable to produce liquid fuel and is also due to the competition of the Standard Oil Company; but, unless the export of Russian kerosene is increased, as the demand from the interior is small, the liquid fuel will contain too great a percentage of dangerous volatile products for profitable trade.

The increased production of kerosene is necessary to supply the fuel residues, and, while the same will meet strong opposition from the United States, success is only possible by Russia adopting the Standard Oil Company's methods for saving, transporting, and delivering the product, which will require a largely increased capital. It is estimated that the amount of $10,000,000 will be required to successfully compete with the American oil in England alone.

Venezuelan Pearl Fisheries.—The pearl fisheries of Margarita, a large island off the north coast of Venezuela, have been known since the island was discovered by Columbus, in 1498, says Consul F. B. Loomis, of Caracas. The great admiral and his officers found the native women wearing strings of pearls, which they were glad to exchange for European trinkets of small value.

Pearl fishing has been carried on by the natives of the island of Margarita as a commercial enterprise for upward of three centuries, and there is no record that within this long period other than the crudest methods have been employed. The annual output of pearls is valued at about $100,000 on the island; that is the sum the fishermen receive for the pearls they gather. How much these same pearls are sold for in the European market there are no statistics to show. It is doubtless true that the fishermen are frequently underpaid for the gems that they find, and that in the past they have been shamefully swindled.

The pearls are bought by a very few dealers, who purchase pearls and other valuable gems for European merchants. There are no restrictions upon the business of pearl fishing in Venezuelan waters, except that a tax of $24 a year is laid upon each boat. There are about four hundred boats employed in this industry, none of which are provided with diving apparatus. Each boat has a heavy metal "scoop-like" drag, which is allowed to scrape along the bottom of the sea till it is believed to be filled with oyster shells, when it is brought to the surface and its contents are removed. Small, smooth shells are never opened, for it is known that they contain no pearls.

The best beds of pearl-bearing oysters are not immediately adjacent to the island of Margarita itself, but are near some smaller islands close by. Around these islands are piled hundreds of tons of shells, the accumulation of centuries of pearl fishing. Many of these shells, I am told, contain a very clear mother-of-pearl which may ultimately be found to have commercial value.

It seems probable that a few well-equipped, economically managed boats, prepared to send down divers and to make some explorations in search of new oyster beds, would reap substantial profits for a few seasons in these waters.

Foundry at Monterey.—The Monterey Foundry and Manufacturing Company is owned almost wholly by Mr. James Meehan, of Kentucky, says John K. Pollard, Consul-General at Monterey. Previous to the purchase of the Monterey Foundry in 1896, it was not a success financially. Immediately thereafter, however, it was remodeled, renovated, and enlarged. It now has a complete modern plant of American manufacture and represents an investment of $125,000. The plant comprises a foundry, machine shop, brass foundry, hammer shop, pattern shop, and a wood-working shop. About 235 men are constantly employed in this enterprise. Most of the skilled mechanics are Americans, who receive on an average from $5 to $8 per day. The laborers are all Mexicans and receive from 75 cents to $1 per day.

A general specialty and jobbing business is carried on. The specialties consist of sugar mills of all sizes, mining and smelting machinery, engines up to 25 horse power, brass cock and fittings of all descriptions, school furniture, architectural iron work, etc. Locomotives are repaired and rebuilt in this foundry. The pig iron used therein is imported from the United States, the scrap iron is procured in Mexico, the steel used in the manufacture of tools and machinery is imported from the United States, and wrought iron is purchased in the latter country and in Mexico.

The business of this foundry has doubled in the last three years and is daily increasing. Its annual sales amount to about $325,000. The duty of 1 per cent. per kilogramme on steam machinery levied by the Mexican government and the duties on raw material, in some instances much higher, are offset by the employment of cheap labor and the difference of freight on the raw and finished material. About 1,000 tons of pig iron are imported annually by this company. The plant is desirably located, being equidistant from the three railroads entering this city, viz., the Mexican National, Mexican International, and the Mexican and Gulf. There are 7 acres of ground occupied by the foundry and owned by the company.

Postal Cars Wanted in France.—Consul Skinner writes from Marseilles, July 6, 1899: I am advised that a project of law has been voted in this country upon the suggestion of the Under Secretary of State for the Department of Posts and Telegraphs, providing for the building of sixty-seven modern postal cars, each 13 meters (42 feet 7 inches) in length. The cars now in use follow a model adopted in 1857, and leave a great deal to be desired. The government will naturally prefer to have the new cars constructed in this country, but, as the American postal cars have advantages greatly superior to anything known upon the Continent, it may be worth the while of American manufacturers to submit propositions.

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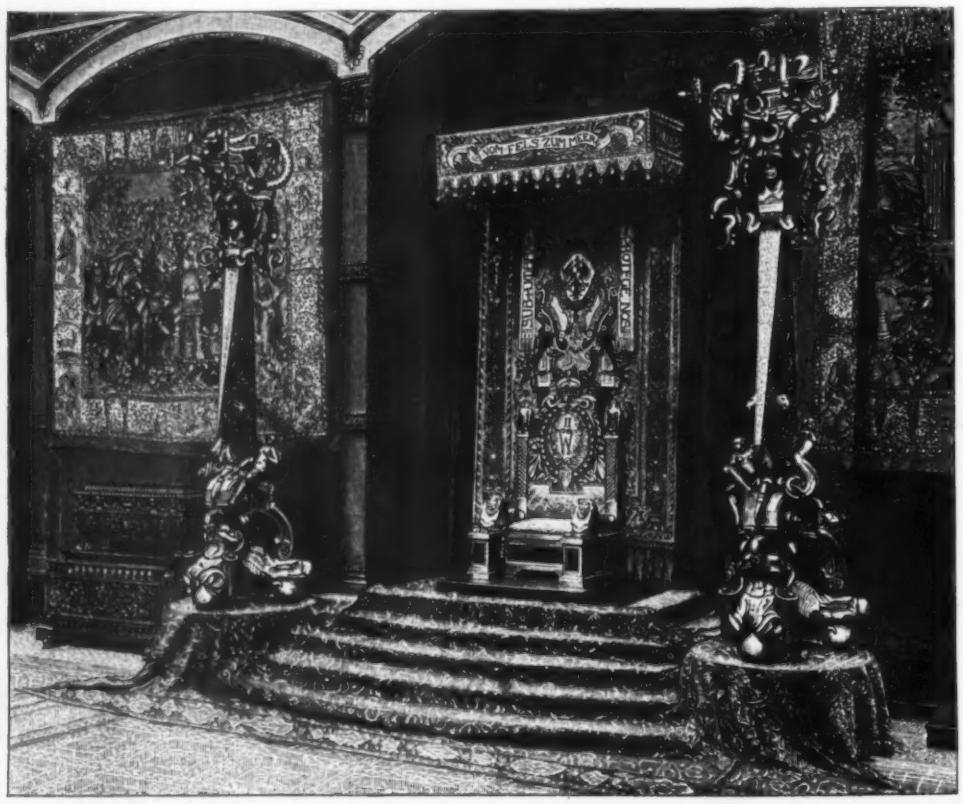
The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

THE PALAZZO CAFFARELLI IN ROME.

ANY one visiting the Palazzo Caffarelli in the heart of the City of the Seven Hills would think that he had discovered a part of Germany itself, for the palazzo is a masterpiece of German art. By order of the Kaiser the great reception hall has been converted into a German hall of state. Once a plain, white, rectangular room in the massive Renaissance castle, the huge hall is now a treasure-house of the best creations of modern German art, among which are four large mural paintings, executed by Prof. Prell, reproducing old German legends in characteristic Teutonic colors and scenes. As his subject the painter has taken from the Edda the Year-Myth of the Earth, telling of the Sun-god Freir and the Earth-goddess Erda. Freiling the young Sun-god has descended to the earth with his companion Skirnir. In a valley beside a brook, purling in a glistening beach grove, swan-maidens, white-winged and slender-bodied, exhort him to free the Earth-goddess held prisoner by the Winter-giants. The entire long wall of the hall is covered by the rich battle scene representing the tempest, a combat between the Sun-god and the clouds, between the Valkyries and the Mountain and Winter-giants, who are compelled to flee to the hills. The liberated Earth-goddess, with her companions upon a flowery hill, urges on the impetuous hero to battle. Gloomy and weird is the winter scene on the side wall. The sun sinks into the sea, which is surging on to bind Earth in new icy shackles. Earth is mourning on a desolate rock; sea-nymphs endeavor to comfort her. Only the bard remains to bewail the death of Nature's beautiful one, and to hearken to the songs whispered to him by the Norns, in whose arms rests the slumbering child of Earth, the future Spring. Bronze figures in groups follow these pictures and heighten the effect of this powerful representation of the combat of Nature's forces. The paintings fringe



THE THRONE IN THE PALAZZO CAFFARELLI IN ROME.

the walls in the Renaissance style, to the beginning of the wainscoting, in which escutcheons chiseled from the marble are set. The brilliant, marvelously deep and fresh colored landscapes, in which the fragrant woodland of Germany predominates, harmonize wonderfully with the dark-paneled, gold-decorated, massive Renaissance ceiling, and with the bright sunny Italian landscape which, with the full magic of its Italian magnificence of color, smiles at one through the four tall windows.

The Palazzo Caffarelli stands high upon the Capitoline Hill. Below lies Rome, extending far over the Campagna.

Our illustration pictures the exquisite wooden candelabra, on which animal forms are carved, harmonizing with bronze groups. The throne canopy, one of the principal decorations of the hall, was embroidered in the Royal Art-Industry Museum (Kunstgewerbe Museum) in Berlin. The tapestry behind the throne presents on the middle field a large eagle with a cartouche, a German escutcheon with a chain for the Order of the Black Eagle. The central field is surrounded by festoons of fruits embroidered in the manner of the Italian Renaissance. Orange damask was used for the ground material, and upon this were sewn old brocades and velvets. The crown and other designs are ornamented with gold and precious stones. The canopy is decorated with a banderole bearing the mottoes of the Hohenzollern family: Suum cuique; Vom Fels zum Meer; Gott mit uns.

Following the example of ancient Byzantine times the throne-seat is ornamented with richly gilded carvings; the arms of the chair are formed by lions couchant whose eyes during festivities are illuminated by electric lights. The back of the chair bears the initials of the Emperor's name on a field of gold brocade. The entire throne stands out prominently from the cold marble background. In our illustration, made from a photograph taken in the Kunstgewerbe Museum for Moderne Kunst, old Gobelins were used as a background.

RELATIVE ADVANTAGES OF DIFFERENT KINDS OF POWER.

THE full title of a paper by Mr. Parker before the Institution of Civil Engineers was "The Relative Advantages of Different Kinds of Power for Tramways, Light Railways, and Motor Car Traffic, both Heavy and Light." A portion of what he said is as follows:

Steam is quicker than horses, less costly for results, but has greater disadvantages, viz., much greater weight and occupying greater length of road, the emission of carbonic acid, carbonic oxide, sulphurous acid, steam, and smoke, practically into the dwellings along the route, and among the people, the unsightliness and noise—making its use in public streets a painful burden to the community, and, as experience shows, not to be borne when better means can be found. The objections leave little hope for the future of direct steam-driven tramways.

The appended costs are taken carefully from practical workings (see table).

Compressed air is a more congenial agent, and has better prospects of success than steam if the two had to settle their differences alone. It is free from many objections compared with steam. There is little interference with the atmosphere. The small amount of direct firing makes it possible to use only one carriage for motor and passenger; water need not be carried. The total dead load to passenger is in its favor. It needs frequent stations for supplies, as the distance it is possible to run with one store of pressure is limited. Its friends are very active at present, and it is hoped we may hear their case and obtain some practical account of its working. It appears to have higher economy than can be obtained by steam direct. The author has no working data he can give.

Cable.—Endless cable as a method of driving tramways has high merits in many respects. It occupies a minimum length of road. Its speed is fair. It is free from nuisances of steam or horses, and it is handy. Its drawbacks are: Heavy initial outlay; its occupation of the street; the slot difficulty, of carrying sewer and other requirements in or across the street in which it is laid; the continued noise of the running rope under the streets causing, in some instances, considerable depreciation in value of property; the stoppage of the whole system upon the breaking of the cable, and the heavy costs attendant upon the system. Taking the statistics of installation, there are very few cable roads being put down now, and we may accept the verdict of the public that the cable has ceased to compete successfully with other methods. There are some tramways being driven by gas engines working on the car, but no reliable practical data is available. The verdict of passengers is that they are required to inhale considerable admixture of coal gas with the atmosphere in the neighborhood of the cars.

Electricity.—At the present time electricity is, by general accord, selected as the best method for driving tramways. In electricity we have a very flexible system which admits of great variation of powers being used at varying points on the same system. There is no nuisance, as with steam or horses. The minimum length of road occupied; speed can be low for intertown work and high for suburban traffic; cars are easily handled; energy is used efficiently; maintenance is not excessive; streets are not more occupied than simply by the pair of rails, so that taking up streets for laying sewers and pipes, or other needs, is not complicated. For lines where few trains are required electricity does not compare with steam, as the capital outlay for running a few trains is the same as for running a number. If we take a case, say, of two towns 50 miles apart, such as London and Brighton, which would support a continuous connection, and by the length of run put electricity under good conditions, electricity could give 15 minutes interval trains, run at 75 miles an hour, doing the distance in 40 minutes by trains of 100 tons, at 2½ pence per train mile, covering cost of power. Such a case shows how completely electricity takes the field under fair conditions, and the advantages are not only in point of power, cost and speed, but the track need not be so costly, as the weight can be evenly distributed throughout the train, the weight of the train being brought in for adhesion and traction. A 100-ton train would be equal in capacity for passengers to a steam train of 140 tons. The cost of maintenance of permanent way and risks would be much reduced. If we turn to a case where electricity is under its worst conditions in comparison with steam, we are able to refer to well matured data. The Liverpool Overhead Railway is such a case. It has been running for nearly seven years, and is in direct comparison with a number of similar lines worked by steam.

A most important difference between electric motors and the steam cylinders when starting into motion is that, in the electric motor, no effort is obtained unless current is passing through the motor, and the torque is proportional to the quantity, while steam gives its efforts and is liberated to exhaust only in proportion to motion.

Motor Cars.—Steam was early in the field, but the requirements needed to make moderate success possible are only of modern achievement. The conditions of the vehicle and road make still further variation of the boiler, engine and condenser necessary before the steam motor car can be a standardized article of manufacture. With regard to gear, steering, brakes and wheels, there are openings for improvements and new applications. There are some good approximations to success of the steam type.

Oil Cars.—Much has been done to render tolerable the close association of passengers with mechanical movements and rapid explosions forming the combination we call an oil car. Still, much is needed with regard to safety from explosion and fire, reduction of vibration and efficient transmission. The prospect is that it may be practical, with reasonable first outlay, depreciation and cost of fuel, to run an oil car successfully for a much less cost than horses. The movement has brought about great improvements in the oil engine, but only light oils have been successfully used. Electricity is chiefly used as a means of igniting. Speeds of 1,000 revolutions are obtained, or 500 explosions per minute.

Electricity.—In applying electricity to motor cars, we first met the question of weight of accumulators. This has, by improved motors, gear and accumulators, within very recent date been reduced to 1 horse power hour delivered on to the car at about 56 pounds inclusive, so that 5 hundredweight of cells is sufficient to operate a car, as against 16 hundredweight two years ago. Motors, gearing, and methods of steering have been much improved. The following data is one of the best examples I have had the opportunity of testing:

Weight of car, complete, without batteries	9 cwt.
Weight of batteries	5 "
Total	14 "
Total weight, with four passengers	20 "
Discharge, on level, 12 amperes at 80 volts	9 miles per hour.
Approximate horse power	1½
Safe distance	40 miles.
One motor, double reduction gear	1,200 revolutions.

OPERATIVE COSTS OF RUNNING ONE CAR-MILE BY THE DIFFERENT SYSTEMS ENUMERATED.

	Horse Traction.	Steam Traction.	Cable.	Electric Overhead.	Liverpool Overhead Railway.
	d.	d.	d.	d.	d.
Drivers' and conductors' wages	2·5	3·5	2·67	2·49	
Generating station, including coal, oil, wages, waste, etc	...	...	*	0·46	
Repairs: locomotive engines	...	1·75	....	....	
Motors	....	....	....	....	
Machinery	....	...	0 84	....	3·9
Cars	....	0·50	0·42	0·037	
Harness, etc	0·92	...	....	....	
Fuel	....	1 65	0·25	...	
Lighting	0·02	0 33	0·04	0 02	
Horses, including forage, shoeing, attendance, renewals, etc	3 61	...	...	...	
Management: general expenses	0 73	1 36	0 18	0·15	0·416
Totals	7·78	8·99	4·40	3·157	4 316
Carrying capacity	26	54	54	30	140
Weight, empty, tons	2·75	12	4·7	4 3	31

* Could not obtain reliable figures for generating costs.

THE TINTOMETER.

THE only practical instrument devised for measuring color is the ingenious tintometer of Mr. J. W. Lovibond. By this instrument the color of a substance or liquid is matched against standard-colored glasses, which are graduated from colorless glass up to the strongest tone that can be graded accurately. Dr. George Oliver has applied the system to the measurement of the red coloring matter of blood, and gave a full account of the method, which is now in use at most of the hospitals and universities, in the Croonian Lectures before the Royal College of Physicians of London last year. It is this red coloring matter that conveys the oxygen from the lungs to wherever it is required in the body, and the general health depends largely on the presence of the correct amount of this material in the blood. An excess generally indicates gout, while a deficiency causes the disease known as anemia, so common among young women. It is painful to look down the scale of the curve and see what a pitiful condition it is possible to be reduced to by anemia. So delicate is the method that the variations in the blood between breakfast and bed time can be traced quite easily. During the day a continual destruction of the red corpuscles is going on, and this deficit is made up during sleep. Among other interesting things, Dr. Oliver found that he and a companion who assisted him were as healthy in London as they were in Switzerland, taking the state of the blood as a

criterion. His experiments were made twice a day for a considerable length of time, and the condition of his blood improved steadily the whole time, from which it would appear that a little systematic blood-letting is good for the constitution.—Chambers's Journal.

ACCIDENT TO AN EXCURSION TRAIN.

OUR illustration shows a railway wreck which occurred on the Turcoing-Boulogne-sur-Mer line in France last month. The train was carrying a musical society called the "Cricks-Dicks" to a religious ceremony which was held in the cathedral at Boulogne.

The train left Turcoing at six o'clock and was descending a grade near Lottinghem, where the track has numerous curves, when the engine and tender jumped the track and rolled over, about 150 yards from the station.

The passengers were thoroughly shaken up and frightened, and seven of them, besides the engineer, were seriously injured.

The exact cause of the accident was not determined by the inquest, but it is said that the engineer was not familiar with the line and ran his locomotive too fast around the sharp curves.—L'Illustration.

ANTARCTIC ICEBERGS.

THE icebergs of the south differ from those of the north as the Antarctic summer from that of the Arctic. In a region where the summer temperature rarely reaches above freezing point, where the attenuated nature of the southern continent allows free play to the polar currents, and where the sun fails to bring out anything that might be called a spring or summer flower, it follows that the ice conditions are vastly different from those of the northern hemisphere, where at a corresponding latitude summer clothes the land with flowers and fills the air with innumerable bees. These widely different conditions are easily seen by a passing comparison of the northern berg with the southern; the former speedily becomes pinnacled and grotesque as it journeys south, while the latter retains its original tabular form in very low latitudes. It is only when the southern berg reaches a distance north where the sun at last begins to make his heat felt that it thaws and presents the great needle points and guttering cascades observed frequently within the Arctic circle.

This difference of temperature between the summer of the Antarctic and that of the Arctic is due to the fact that, while the latter region is a polar basin, surrounded by vast tracts of land which retain the summer heat, the former is a comparatively small tract of land in a tremendous expanse of water, which parts with its heat very quickly.

The home and origin of the southern berg are a matter full of romantic interest. In 1774 Captain Cook sailed down into the unknown Antarctic regions, and after terrible hardships reached a spot where he saw a snow-white brightness in the clouds to the south, and he knew he was near the ice fields. Four hours later he was stopped by a great ice barrier in latitude 71° south, where the mountains of ice, rising one above the other, tier upon tier, into the distance, were lost in the clouds of the polar sky. The desolate grandeur of that icy coast appalled the great navigator, and, seeing no possibility of pushing to the pole over those impassable mountains, he contented himself with having gone further than any one had ever been before, and, he thought, as far as any man could go. He speaks of vast glaciers descending from the interior, and of ice islands and floats near the coast; and from his remarks it is easily seen that he had found the home of the southern bergs.

The glaciers, coming slowly down from the interior, being launched between the mountain sides of this ice-bound, continental coast, produced the tabular icebergs by snapping off from time to time at their extremities, and these, once set free, sailed northward in due time on the ocean currents. This barrier discovered by Cook was evidently an outstanding coastline of the Antarctic continent, for, more than half a century later, Sir James Ross, in the "Erebus" and the "Terror," found a similar barrier, probably continuous with that of Cook, at a far higher latitude of 78° south. Here at the feet of the great volcanoes, "Erebus" and "Terror," so named after his ships, Ross found a further home of the berg.

This coast of Victoria Land was a grand scene of glaciers launching their gigantic ends into the sea. From the coast line, where the walls of ice stood as sheer cliffs hundreds of feet high, the mountains inland ranged one over the other, culminating in the volcanic peaks 12,000 feet high. And down the grooves of these mountains came the slow-moving glaciers to people the southern seas with the floating dangers which render exploration there a thing of intense risk to the boldest and most skillful navigator. Ross says this ice barrier is "perhaps more than one thousand feet thick, . . . a mighty and wonderful object."

As the ice barrier, so the bergs. When they are set free they are solid fragments of the parent glacier, with tops like billiard tables and sides like cliffs, often measuring as much as two hundred feet in height and several miles in extent. They maintain their tabular character generally and their vast size until they either collide and break up or suffer a thaw in low latitudes. In the former alternative they supply the material for the floating ice packs, and in the latter they assume strange shapes, turreted, pinnacled and undermined, as, like glistening fairy palaces, they slowly dissolve beneath the sunlight. Cook mentions several interesting bergs with which he made acquaintance. One was fifty feet high and half a mile in circumference. He says: "It was flat at the top, and its sides rose in a perpendicular direction, against which the sea broke exceedingly high." This berg must have been from a barrier not very far south, for the further such a barrier is from the pole, the thinner the ice becomes.

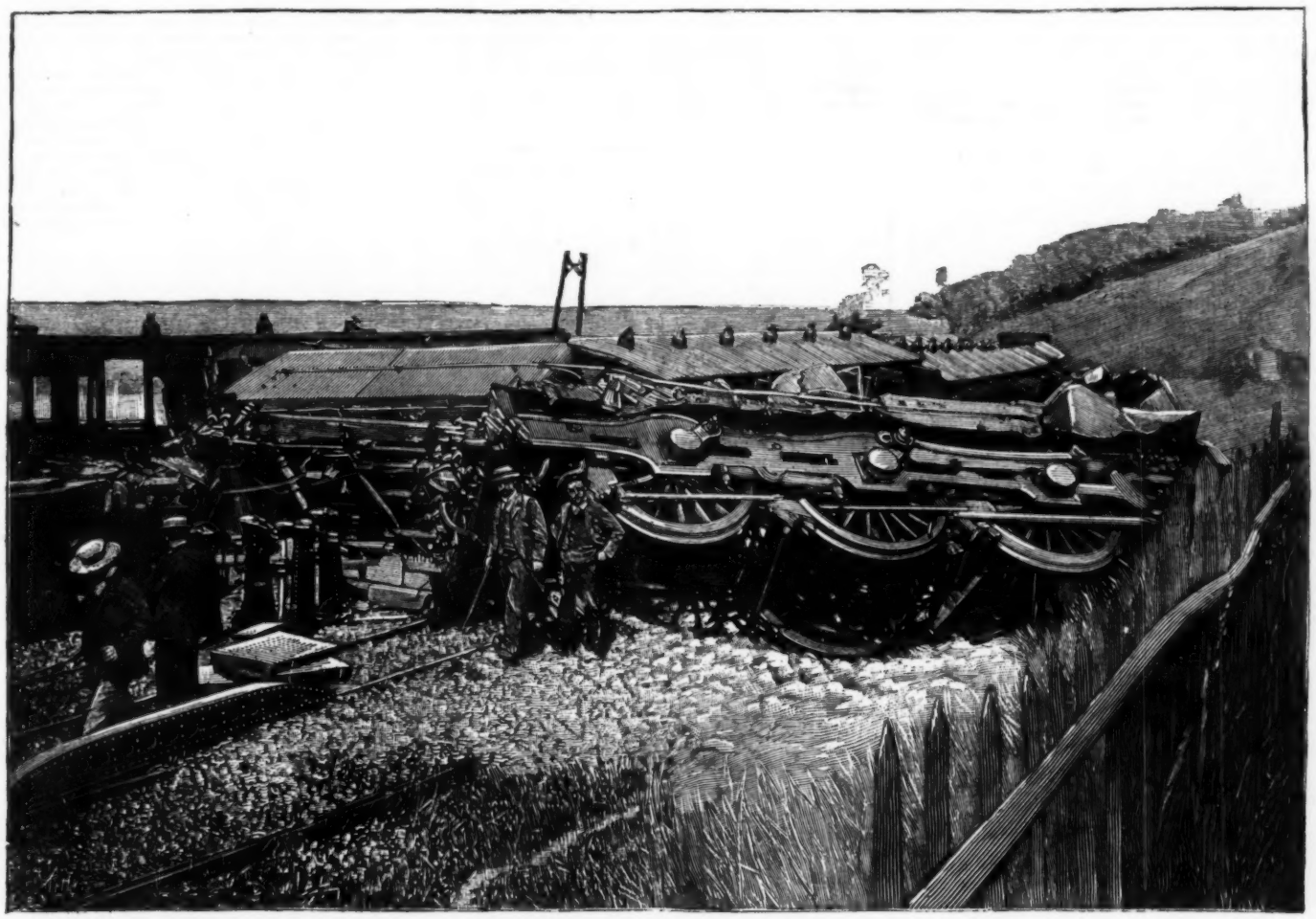
In regard to this point it may be mentioned that in 1893 Larsen found in Graham's Land a barrier which, being in a comparatively low latitude, was only from twenty to sixty feet high, while that discovered by Ross in latitude 78° S. was very much higher. D'Urville, the gallant French explorer, met with bergs in latitude 59° S. It would appear from this that their place of origin was an ice barrier even further south than that found by Sir James Ross. The Dundee whalers in 1892–93 also saw bergs over two hundred feet high; these, too, in all probability came from a barrier which Dr. Murray is of opinion faces an open sea for some distance south of Ross's Ultima Thule. And, if there be an ice coast still further south, it is vaguely hinted at by Mr. Bull's measurements, in 1896, of a berg six hundred feet high, which at first he mistook for an island.

A thaw among Antarctic bergs is not often met with even in the height of summer; but to show that such a thing does occur occasionally, the experience of Ross may be mentioned. On one occasion when he was considerably within the Antarctic Circle the thermometer stood at 12°, but in the bergs all around there were evidences that they had suffered a partial thaw some time previously, for great icicles hung from their sides. On another occasion outside the circle he saw a complete thaw attended by sounds like the discharge of heavy artillery, as the huge masses split and fell apart. But, although the bergs are seldom melted in high latitudes, they have another way of disposing of themselves; they run into one another and break up into small junks, which strew the sea for miles around. The dense icepack thus formed is one of the greatest dangers to navigation in those regions; indeed, the struggles of men with the everlasting icepacks form the main part of the interesting history of South Polar exploration.

In his first voyage Ross forced his way through a pack two hundred miles in breadth, and in the following year he found this same pack increased to eight hundred miles. On this occasion it cost him just eight weeks of the short southern summer to force his way through. Part of the way he proceeded in a novel fashion, with the "Erebus" lashed to one side of a small berg and the "Terror" to the other. This method succeeded well, for the berg caught both the wind and the deeper currents, and forced a way among the lesser junks of ice, but when a storm arose some time later this method of procedure had to be abandoned. Then the fragments of ice in ceaseless commotion carried away the rudders of both ships, but, after innumerable dangers and hardships, including being constantly butted about by the floating ice like a foot-ball in a scrimmage, he eventually gained the other side, where he found a clear sea. It was on this same voyage that the "Erebus" and the "Terror" collided in the night while trying to avoid a berg immediately ahead. The "Erebus" being disabled was for some time in great danger of being altogether wrecked upon the cliffs of the berg, but at last succeeded in drawing off.

D'Urville's gallant battles with the icepack were worthy of that heroic Frenchman. On his first voyage he entered a dense pack in latitude 63° south, the whole field glistening like alabaster in the bright sunlight. He tried to force his ship through, but got hemmed in during the night, when, to make matters worse, a gale arose, and he describes his ships as being like two stags in a high-walled park, pursued by relentless dogs in the shape of fragments of ice. The snow came on, and the ships were butted and shaken by the battery of floating ice blocks till he had to choose between being jammed and snowed up in the thick of it or making a dash for the open sea. Choosing the latter course, he cut his way out with levers and saws at the rate of a mile in ten hours. The American Wilkes also suffered severely in the icepacks, one of his ships, the "Peacock," being completely icebound in latitude 66° south. It was at this time that he found some bowlders on the top of a berg and guessed they had come direct from the great Antarctic continent. In the same latitude Svend Foyn's expedition in 1896 was completely icebound for a fortnight in a pack 500 miles in breadth.

The dangers of these belts of ice, coupled with the terrible risk of running into bergs in the heavy fogs



ACCIDENT TO A FRENCH RAILWAY TRAIN.

which frequently obscure the southern seas, make the conditions of south polar exploration almost overwhelming even for a modern ship equipped with steam and other recent advantages. What the difficulties must have been to Ross, who had to explore without steam, can be imagined. And when one thinks of Capt. Cook, who had not even an ice-fortified ship like those of Ross, one feels bound to accord to him the title of the greatest navigator the world has seen.—London Globe.

WEST INDIAN HURRICANES.

By Dr. EUGENE MURRAY-AARON.

THE indescribably relentless fury of a West Indian hurricane is understood by no one who has not experienced it, and such as have, who live to tell the tale, have usually but a dull and benumbed sense of the events of the brief moments when the full force of that fury was upon them. The ability to observe and properly record the events of such soul-trying times as come with the full impact of a hurricane center is rare, and many of those who have had it, have all too frequently disappeared with the storm that they essayed to observe.

An inspection of a map of the West Indies and the adjacent mainland, from Cuba and Yucatan on the northwest to Venezuela and Trinidad on the southeast, shows in the center a great salt water caldron, some seven hundred miles wide and seventeen hundred miles long, and for the most part surrounded on all sides by more or less continuous mountain chains. On the north and east these chains of mountains, long since subsided into the ocean, show themselves in the peaks and ridges which contribute so much to the beauty and climatic excellence of the West Indian islands. Among these the crowning dome of the Cibao Range in Haiti and the Blue Mountain Peak in Jamaica, each about one and one-half miles high, are the culminating points. But it is on the west and south in Central America, Columbia, and Venezuela that this caldron is surrounded by the highest, least broken chains, and it is doubtless from the sides of the sub-Andean Cordilleras that come the initial impulses which stir this caldron, every now and then, into "a veritable seething, watery hell."

Some years ago, having been appointed by General Greely to a West Indian post where an outlook was to be kept for the dread storms that are momentarily expected during the late summer and fall, and whence twice daily our Weather Bureau at Washington, then under the general's able control, was informed by cablegram of the meteorological doings in that uncertain vicinage, I formed an initial acquaintance with the West Indian hurricane that I found it of interest to cultivate. From ship captains familiar with those waters and from many natives of the region I have heard tales of suffering and danger, some of which, although told by men above reproach, sounded almost too marvelous to be true. From a resident of the island of Barbadoes, who had been in the midst and accurately observed one of the most remarkable and destructive hurricanes of this century, I quote the following as an excellent description of the fury of one of these storms. After describing the weather and the meteorological phenomena that led up to it, and alluding to the wonderful displays of the electrical currents that are usually prominent factors in these storms, he said: "The lightning's coruscations, for the short space of time they continued, instantly succeeded each other; this strange quivering or darting of flashes down and up may be compared to the miniature blazing produced by the rapid and irregular discharges of opposing artillery, closely engaged. While this remarkable phenomenon proceeded, the earth vibrated in a manner and in time answering with the action of the lightning. Twice or more, when the coruscations were more brillant and intense, but less rapid in succession, the earth received correspondent shocks. The moment after this singular alternation of lightning, the hurricane again burst from the western points with a violence beyond conception, hurling before it thousands of missiles, the fragments of every unsheltered structure of human art. The strongest houses were caused to vibrate to their foundations and the surface of the very earth trembled as the destroyer raged over it. No thunder was at any time heard; had the cannon of a hundred contending armies been discharged or the fulmination of the most tremendous thunder claps rattled through the air, the sounds could not have been distinguished. The horrible roar and yelling of the wind, the noise of the tumultuous ocean, whose frightful waves threatened the town with destruction, if all the other elements might spare; the clattering of tiles; the falling of roofs and walls, and the combination of a thousand other sounds, formed the most hideous din, which appalled the heart and bewildered if not alienated the mind. No adequate idea of the sensations which then distracted the mind and confounded the faculties can possibly be conveyed to those who were distant from the scene of terror. The sheltered observer of the storm, amazed and in a state of stupor, was fixed to the spot where he stood; the sight and the hearing were overpowered, and the excess of astonishment refused admission to fear; what must have been the mental agonies of those wretched fugitives who, destitute of a place of refuge, were the sport of the dreadful and ruthless tempest, and alive to all its horrors! This unparalleled uproar continued without intermission for over three and one-half hours, the raging blast then veering from the west and other points to the southward of it, attended with avalanches of rain. The storm now and then for a few moments abated, at which time, the dreadful roar of the elements having partially subsided, the falling of tiles and building materials, which, by the last dreadful gusts, had probably been carried to a lofty height, the shrieks of suffering victims, the cries of terrified inhabitants, and the howling of dogs, were clearly audible, and awakened the mind to a distressing apprehension of the havoc and carnage which had been and still were desolating the island. . . . Almost every merchant ruined and few of them possessing so much as a suit of clothes to walk the streets in. Every vessel thrown high up into the bay. . . . A piece of lead which weighed 150 pounds was carried to a distance of more than 1,800 feet, and another piece, 400 pounds in weight, was lifted up and carried a distance of 1,680 feet. Rafters and beams were flying through the air with frightful rapidity, and shingles pierced in several instances hardwood trees and remained sticking in them. Another instance is related that part of a child's trumpet was driven into an evergreen tree, where it buried itself in the trunk. If an object so light as a piece of tin be driven into wood, the force required to bury it in the tree may be imagined."

On a trip through the interior of Haiti it was my good fortune to witness, from the upper reaches of the Cibao Mountains, the full fury of a hurricane the upper edge of which was some 2,000 feet beneath me. I had frequently watched thunder storms from such elevations, when far above the dangers and discomforts and surrounded by clear sunshine; but never before nor since have I had an illustration of just what the irresistible force of a hurricane is capable, when sufficiently removed from it to be perfectly free to do nothing but observe with all my powers, unmindful of the pressing need of self-preservation. No mowing machine ever cut a straight and clearly defined pathway through a field of waving grain with greater ease or precision than did this whirling, ink-black cloud plow its way along a mountain side, across a valley, perhaps four miles wide, and up and over another range of foot hills and so out of sight. The storm had been gathering all day; scurrying clouds, oddly resembling mighty hands with quivering outstretched fingers, had from dawn been coming up from every point on the horizon and seeking a common center over the hot valley below me. By noon there was everywhere a heavy, shimmering haze, an unusual manifestation in a land of clear and transparent atmospheres. Then for two or three hours had grown, especially toward the south and west, an uncanny, sulphurous glare; with the cloud over the central valley growing blacker each moment. From above, where I was making camp for the night, this cloud looked to be so full of water that but one clap of thunder appeared to be needed to shake it empty.

As I busied myself with the details of camp life, an odd thing claimed my notice. The cloud, which at first had appeared saucer shaped and much notched on the edges, had suddenly changed to a resemblance of an inverted funnel and was revolving at a rate that made it seem quite smooth and of even roundness. At that

Map Showing Movement of a TYPICAL WEST INDIAN HURRICANE: August 15–18, 1893.

time it was over the valley or arroya of a stream which was then, after a long dry season, a perfectly minus quantity. As the speed of the whirling cloud increased, its dull moan being now plainly heard, though I was quite two miles away, I could see through my field glass that pieces of dried twigs and branches were being lifted up into the black vortex. I was much too far away to clearly distinguish one thing from another, but I could plainly see that what appeared to be sucked up by the center of the whirligig, if I may use so unscientific a term, was in time hurled forth from some part of the periphery. Although by this time the speed of the outer edge of the revolving cloud must have been very great, judging by the way in which things were hurled by it, it began its geographical motion at a very slow gait. Indeed, I do not think that at any time it was moving across the country faster than six or seven miles an hour. The harm that it did was due entirely to the force of its centrifugal motion. It impressed me much as has a swinging buzz saw, such as is used in large mills to cut off the ends of timbers and boards. It was not the speed or force with which it approached an object, but the terrible power due to its rapid revolutions that worked havoc wherever it passed.

Having followed the dry gully until it reached the foothills below me, it came upon a considerable extent of woodland, mostly large growths of logwood, with some larger Santa Maria and silk-cotton trees scattered through it. The taller growths that were in its path were snapped off like dry grass, but at that stage the storm had not attained sufficient force to do so much damage to the low and compact growing logwood. Then there began to appear decided manifestations of electrical energy. At no time was I aware of a thunder clap heard above the roar of the whirlwind, which now was a loud, hoarse roar; nor do I think that there were any well defined bolts of lightning. Rather were there vivid lightings up of the cloud from within, with angry tongue-like manifestations on its edges; but the electric current showed no disposition to leave the cloud in which it appeared to have been generated. When the storm center reached the hillside on the other side of the valley, whereon there was a dense growth of virgin forest, I am inclined to think that the electric current may have been communicated to the ground through many of the larger trees. At any rate the lightning grew less vivid, although the roar and fury of the hurricane had increased. And when I visited the scene of the storm on the next morning, I saw unmistakable signs of the lightning having torn some of the trees asunder. At this point the storm veered at an angle of nearly 30 degrees and plowed its way directly up the bed of a mountain gully. Along this, for a space averaging about 200 yards wide, it cut its way as clearly and as irresistibly as though trees were weeds and bushes grass. Long after it had crossed this hill and dipped down into the valley beyond, I could hear the storm's roar and see the reflection of its electrical display on the lowering heavens above it.

This was a small storm, a toy hurricane, I know; but it was sufficiently large to illustrate how these terrors of the West Indies start out, and how each minute adds to their force and fury. And, too, it was quite large enough for my comfort. Had its boundaries been three or four times as extensive as they were my opportunities for placidly sitting down and taking notes of its principal attributes might have been suddenly and fatally curtailed. An experience that I had in Candlestick-Tree Gorge, in the Blue Mountains of Jamaica, with a much smaller hurricane was quite sufficient to assure me of my utter unfitness to cope with such a storm and take note of its nature at the same time. Then I had all I could do to keep myself and broncho out of the way of flying tree limbs, and with my back to the driving blasts, gasp for air in the water-laden atmosphere.

The disasters from West Indian hurricanes of the year 1893, which carried death and desolation in their train along our Atlantic coast, familiarized us with the nature of such storms to an extent that it may be hoped will not soon again be the case. Three severe storms, in August, September, and October, made that year a memorable one in this respect. The storm that progressively raged from the West Indies to New York during August 15 to 20 of that year, and which is the one that is believed to have overwhelmed the steamship "Alvo," and is known to have wrecked the steamship "City of Savannah" and quite 200 lesser vessels, vividly recalled one at about the same period in 1873. That storm traversed much the same latitude, and in it about 225 lives and over 1,200 seagoing craft were lost. The fishing industries of the Atlantic region, from Florida to Newfoundland, were estimated to have surtained quite $3,500,000 loss thereby. In the like storm of 1893, although it was fitted to do even greater damage, the increased efficiency of our Weather Signal Service showed itself in a loss to shipping of but about one-sixth; but the fact that "land lubbers" have not yet learned to depend on these warnings is attested by the fearful loss of over 1,000 lives in the sea island regions of Georgia and South Carolina. This same region was also the sufferer from a storm of like fury in 1880, when Savannah alone lost over 600 people and sustained a loss of $2,000,000 to property.

While the fury of these storms in their native places is greater than that of our western cyclones, their appearance on our coasts is so gradual and we are now so thoroughly warned by our Weather Bureau that great loss of life can only now be attributed to criminal neglect on the part of the people in paying no attention to these warnings. When it shall dawn upon those going to sea and those living in specially exposed regions that these warnings are really meant to warn, such great loss of life as we have in the past witnessed will cease to be possible. These storms have usually lost some of the fury with which they are wont to visit certain of the West Indian group by the time they reach the Atlantic coast. None has yet nor is ever likely to do the terrible damage that befell Savannah la Mar, Jamaica, in 1744. That thriving town, rich with the gains from sugar and rum on land and endless freebooting by sea, was in one dread hour so utterly swept from existence that not one dwelling, not one soul, nor ox, nor horse, was left as a reminder of the furies that saw the sun go down on a thriving community and its place covered by morn by many feet of sand cast up by the mighty tidal wave that had come as the fitting climax.

One of the most remarkable storms of very local origin that has ever visited the Northern Atlantic was the storm of August, 1885, which swept up the Delaware River and across its sudden bending at Philadelphia, and killed six persons and more or less damaged over five hundred houses in Camden, N. J. A careful, dependable observer, writing of that storm, says: "It was my rare good fortune to be standing on Harding's Fish Wharf, at the foot of Dock Street, Philadelphia, as this furious tornado came rushing up the river, plowing the water in deep grooves and carrying before it a wave that swamped all small craft that were so unfortunate as to be caught in its fury. Hard as it is to realize, it is, nevertheless, a fact that a full-sized ferryboat, bound New Jerseyward, was lifted high on the crest of the wave and while in this pivotal position was whirled completely around and found itself afterward, without the engine having been reversed, bound for the Pennsylvania side." This remarkable combination of wind and wave gave rise to a story, widely circulated, that "a ferryboat was blown entirely out of the water and put down in a reversed position," to quote a sensational paper of the following day; the reality was, however, sufficiently unique and remarkable.

The storm of August, 1893, afforded a good illustration of just how completely our Weather Bureau keeps in touch with the doings or idiosyncrasies of any approaching storm and of how well able it has been for some years to save life and property by timely bulletins and signals. The accompanying map shows just where that storm was known to be at various times; as it was published by the bureau before written reports could reach the Washington office, and as it was afterward found to be accurate in every detail, the value of telegraphic, abridged reports from various West Indian points was fully attested. This intimate knowledge of the progress and approach of the storm enabled the bureau to warn the observers at Cedar Keys, Tampa, Key West, Jupiter, and Jacksonville, Florida, at the Georgia and South Carolina stations especially, at

Moorehead and Washington, North Carolina, at Norfolk and Fortress Monroe, Virginia, and the secretaries of the Maritime Exchanges of Baltimore, Philadelphia, New York, and Boston, of the danger to shipping, etc., that was approaching them. The loss of life that was prevented and the saving to property that resulted from these timely warnings, heeded by all well informed men, are incalculable; the latter surely involve an amount sufficient to support the bureau, whose work it was, for the following decade.

Most of these storms approach us by way of or close to the Bahama Islands. These are British possessions, and their being such suggests the need of close combination between Her Majesty's government and our own in this work of storm observation. Prof. Maxwell Hall, of Jamaica, more than any other Englishman, has added to our recent knowledge of this subject, but there is a need for several trained scientific observers, who should be well paid, in other parts of the British West Indies. The need for one or more safe, deep water harbors near the Bahama Channel, for the establishment on several of those islands of telegraph-connected stations, and for a special service for the destruction of derelict craft—the natural and menacing results of these hurricanes—is very great and pressing. It would seem that the present era of good feeling was a fitting time for the perfection of an arrangement between this country and Great Britain whereby a share of the expense would, as it should, be borne by us.

Much can also be done and much is being done by careful observation from non-technical observers; naval officers and those of the merchant marine do much in this respect. No doubt, also, with our acquirement of territory where these storms originate or do their greatest damage, as witness that of August 7 to 9 of this year, our Weather Bureau will increase its force of skilled observers in all that region.

If but little has been here said regarding the generic nature of these storms, it is solely due to the fact that so little is really known, as much as may be guessed at. The semi-placid vortex, the wonderful and destructive speed of the outer edge, the terrible suction of joining currents, and the rather slow but remarkably steady progress of these whirling forces as a whole, are characters that appear to hold good throughout; they are generic. The electrical and barometric manifestations, the general courses resulting from certain rotary motions, the sky and cloud signs preceding such storms, appear to be specific and contain the key-notes to a classification that will prove eventually to be of the first importance.

THE IMPORTANCE AND THE PROMISE IN THE STUDY OF DOMESTIC ANIMALS.*

IF it should be asked why we emphasize the study of the heterogeneous series of animals that have been domesticated by man, we reply that it is because no forms in the range of zoology offer a greater reward in relation to the problems of life, or more decidedly affect the prosperity, happiness, and progress of the human race.

By tabular arrangement two only of the great group of the invertebrates are prominent as having been domesticated, namely, the honey bee and the silk worm. Among vertebrates are, of birds, the natatores, such as the goose, duck, and swan; the Gallinæ, as the hen, the turkey, and the peacock; the Columbinæ, as the pigeon; the scansores, as the parrots; the passeres, as the canary bird; the raptores, as the falcon; the cursores, as the ostrich; of mammalia, among the Ungulata, are the horse, the ass, the pig, the camel and dromedary, the sheep, the goat, the ox, and the elephant; of carnivora, the dog and the cat; of rodentia, the rabbit and the guinea pig; and of primates, monkeys, apes, and man. It will be observed that five of the eight orders of birds have domestic representatives, and three of the nine orders of placental mammals.

What will be the influence of the study of the domestic animals (1) on the doctrine of the evolution of organic forms, (2) on comparative anatomy, embryology and physiology, (3) on hygiene and preventive medicine, and (4) on theories of heredity and sociology?

In the words of Darwin, "It is of the highest importance to gain a clear insight into the means of modification and coadaptation. At the commencement of my observations it seemed to me to be probable that a careful study of domesticated animals and cultivated plants would offer the best chance of making out this obscure problem. Nor have I been disappointed. In this and in all other perplexing cases I have invariably found that our knowledge, imperfect though it be, of variation under domestication afforded the best and safest clew. I may venture to express my conviction of the high value of such studies, although they have been neglected very commonly by naturalists." A quotation was also made from Prof. L. H. Bailey to show as the best proof of evolution that plants and animals are profoundly modified by different conditions, and that these modifications tend to persist. Every cultivated plant has been so modified that people dispute as to what wild species it came from. It is immaterial whether we call the new forms species or varieties, or even genera. The distinct business of the horticulturist is evolution. Almost as strong proof can be brought by stock breeders and fanciers.

One of the domestic forms of life gave the final demonstration. The five-toed form of the basal Eocene in our own country gradually became four, three, and finally the one-toed horse, with its allies the ass and the zebra. Long before the coast range was brought forth, the primitive horses disported here and passed hence to Asia, Africa, and Europe, only to come back again in these latter days to this so-called "new world," after making the circuit of the globe. For most of the domestic animals it is usual to bring in a hypothecated fossil type; but with the pigeon reversions to the parent form often occur, so that it is agreed in regarding the original stock as the wild rock pigeon. Really only a beginning has been made in this great field, and there is rich promise of returns for future study of domesticated forms of birds and mammals as throwing light on evolution as the method of nature.

Consider the help the domestic forms have given to anatomy, embryology, and physiology. The structure of man has been the most thoroughly explored, then come the horse, dog, cat, and rabbit. Most of this was for its practical bearing on surgery and medicine. There has been a tendency on the one hand to regard parts as alike which have only a fancied relationship, and on the other to ignore real kinship. A revision is needed so that the student can pass from form to form and more easily correlate truly homologous parts. Test it by asking anyone familiar with the limbs and joints of man, horse, dog, chicken, and honey bee, but is not trained in advanced anatomy, to name them. Such an experience would convince an open-minded inquirer, and also fill him with admiration for the view of organic nature that points out real likenesses in what at first seemed so diverse. What embryologist is there who did not get his start by studying the development of the domestic animals? So with the student of physiology. What is known in these fields is as yet but a drop in the bucket, and as the domestic animals have contributed the greater part of that drop, so they will be called on to fill it to the brim as time goes on.

What a splendid outlook there is at present. New discoveries in physics, like the X rays, make advances possible in physiology; and perfection in microscopic technique aids embryology. There is not one treatise in any language that adequately deals with the embryology of the domestic animals, and the only one in English is hopelessly antiquated. The embryology of the present day professes to deal with the entire development of the individual, while it really deals with only the earliest stages and the beginnings of organs. The complete ontogeny of the individual should trace development from the ovum through to old age and death. Abundant material is at command among the higher groups of domesticated animals, without very great expense, for that full knowledge required for satisfactory monographs. It may be had at every large abattoir or village slaughter house. And that it is being utilized appears from the laboratory announcements of Harvard, Johns Hopkins, and other centers of investigation and instruction.

The pressing need of zoology to-day is complete knowledge of some typical forms, rather than more bits and patches from the entire animal kingdom. Morphological knowledge is too much like a crazy quilt, as every investigator finds to his cost who wishes to carry a research beyond an elementary stage. What is needed is concentration, and complete knowledge compassing the entire life cycle of each form investigated. Not only the beginnings of organisms, but their ontogenetic development after birth, is of profound biological importance. How a new-born becomes an adult is as interesting as how an egg becomes an animal. A few years ago the agricultural experiment stations of New York and Wisconsin tried to answer the question as to how by nutrition and growth to render animals most satisfactory as food, and also most profitable in the market. Questions arose as to changes in muscle in passing from youth to maturity, and from maturity to old age, and also as to the conditions of leanness and fatness. These pertinent questions only a biologist could answer, but most of the answers were shrouded in darkness. But during the year 1899 several investigations bearing on these points have been published. Every one knows that the muscles increase in size and strength in a growing animal, and also by exercise they increase in an adult. But who would have been prepared to find that in this increase of power and size of the whole muscle the individual fibers of which it is composed would actually decrease in number? Read Dr. Minot's address at our Indianapolis meeting in 1880, and the papers of Hodge on the changes in nerve cells from childhood to senility, and a notion will be gained of the rewards due to the faithful, clear-brained investigator.

Let me remind you again of the brilliant part the paleontology of the horse has played in zoological science, and let me express the belief that its embryology, when worked out, will play an equally brilliant one. At present this embryology is only known in fragments. Why should there not arise in this boundless western world, in the land where the earliest horses appeared, some embryologist who, with the cheap and abundant material at hand, should work out this problem with completeness? Next to man himself there is probably no animal in which the civilized world is more profoundly interested. To trace in the growing embryo not only its own life history, but to gather as many and clear glimpses as possible of its race history would indeed be an inspiration. Enough is already known to make one sure that the field is worth working, and that the harvest is certain. Almost as much might be said for some of the other domestic animals. Why should not some of this splendid work be done in America? This home of the horse had representatives of all the groups of domestic animals, and every summer brings from its boundless treasures ever new and more marvelous forms.

The honey-bee and the silk-worm should not be passed by without a word. Their history is shrouded in darkness, but they are still with us and offer problems for the attentive biologist. Take, for example, that great question of apparent voluntary parthenogenesis with the bees. What is the mechanism by which fertilized eggs become queens or workers, and unfertilized eggs become only drones? Is this general belief really true? If true, what are the differences in the course of development in the eggs in the two cases? Then again, in physiology, what a multitude of problems the bees propound. Why will a special form of food cause an egg to develop into a queen instead of a worker? How can the workers change honey into beeswax? How can a mere blind pouch serve the purposes of digestion and excretion in the larva? For answering these questions the honey-bee is admirably adapted. One can keep the swarm constantly under his eye, and he can control, so far as necessary, the actions of the bees; thus there is an abundance of material to be had at all stages.

Indeed, with the hundreds of thousands, perhaps millions, of insect species yet to be described, and questions to be answered as to structure, function, embryology, transformation, histolysis and re-development, it looks as if the entomologist would not, for some time yet, be compelled to sit down and sigh for new worlds to conquer. And to carry our convictions over from the vertebrates to the invertebrates, I think zoology would be far more advanced if a million or two species of insects were left undescribed, and the enthusiasm and devotion of the entomologists were directed toward the elucidation of the entire life-cycle of a few typical forms, whose structure, function and embryology were worked out as completely as modern knowledge and method would allow. Then there would be some standards of comparison to facilitate the work on the infinite number of forms still uninvestigated. From the monographs on the embryology and morphology of insects which have appeared during the last few years, one cannot help feeling that this fascinating field will soon claim a multitude of students, and that none need go away empty-handed.

In preventive medicine and hygiene the domestic animals have served as the basis for study and investigation. At the close of the last century Jenner's application of cow-pox as a protection against small-pox led to the almost complete expulsion of that once dreaded scourge from civilized lands. Pasteur in 1866 pointed out the need of cleanliness, fresh air and good food for the avoidance of degeneration and disease in the silk-worms; and are not these the foundation stones of hygiene for all animal forms? In silk-worms Pasteur also found causes for disease in the microscopic organisms which infested their bodies; and in some cases this cause appeared to pass from one generation to the next through the eggs. What this study of Pasteur upon diseases of silkworms, upon anthrax in the domestic mammals, and upon fermentation, did for surgery is thus expressed by Lister, the recognized father of antiseptic surgery, at the jubilee celebration of Pasteur: "Truly there does not exist, in the entire world, any individual to whom medical science owes more than to you. Your researches on fermentation have thrown a powerful beam which has lighted the baleful darkness of surgery, and has transformed the treatment of wounds from a matter of uncertain and too often disastrous empiricism into a scientific art of sure beneficence. Thanks to you, surgery has undergone a complete revolution, which has deprived it of its terrors, and has extended almost without limit its efficacious power."

The working out of the biological relations of the Texas cattle fever seems to me one of the most brilliant pieces of scientific investigation that has illumined our age. It took one of our foremost pathologists (Dr. Theobald Smith) three years to bring his investigations to a demonstration. And little wonder! For instead of the previously known, simple relations of microbes to disease, the way was round about, and involved two generations of animals and two species. Furthermore, the germ of the disease was not a bacterium, or fungus, easy to cultivate on artificial media, but one of the sporazoa for which no artificial medium has been found. The story is as follows: Cattle ticks suck the blood of animals in which the Texas fever germ is present. The germs enter the eggs of the ticks and thus infect the next generation. This new generation of ticks attach themselves to other cattle and introduce into their blood the disease germs that were carried over from a previous generation. The direct human interest, outside the economic one, is the suggestion and the accumulating proof that malaria, in man, is transmitted by mosquitoes in a practically similar vicious circle. Truly the living hypodermic syringes are to be feared as well as execrated.

Thus hardly a triumph has been won in medicine without aid from the domestic animals; and it is believed by the acutest minds engaged in the great work of ameliorating the sorrows of the world caused by preventable disease and premature death, that we are now only on the threshold of discovery. Is there not, in these facts, reason for raising the veterinary profession as a true unit in university life, and a close colleague with the profession of human medicine? And may not the latter reap even greater good in the future by a more thorough appreciation and study of comparative medicine?

When the twilight of the twentieth century is already in the sky, no problem is more important than that of heredity. What is its mechanism, and what light does it throw upon the chances for preservation from degradation, and for elevation to exalted manhood? Organic evolution has clearly shown that "descent with modification," in order to meet the requirements of environment, does not by any means signify, in all cases, what is commonly meant by the term "progress." Consider the mental and physical condition of parasites. They have descended literally and with the profoundest modifications. Look at the serpents and the partly limbless oceanic forms. In their descent they progressed toward fitness for their environment, and to make the most of their life. But the Utopia for human life is where there is abundant food for all, congenial labor for all, and education and amusement for all; everyone to work out in its fullness his own individuality, and at the same time serve the common weal.

What lessons do domestic animals give on this? That "like produces like" is a generalization believed in by every one and proved by daily observation. Equally true and general is the statement that "like produces unlike;" that is, no offspring is exactly like its parents, and no two offsprings are exact duplicates. While the race type is persistent, individual modifications are infinite. Here is the hope and the despair of mankind. The hope, because every horticulturist, every stock breeder, every parent, hopes that the offspring will be unlike, but that the unlikeness will be an improvement. The despair, because unlikeness is just as liable to take the trend of the undesirable qualities and intensify them. With the lower animals the undesirable modifications must be eliminated, or the race will deteriorate. In the human family the problem is equally plain, but infinitely more difficult of solution. How can the brood of criminals be avoided and the sturdy and right-minded possess the earth?

If one would see how social theories have worked themselves out successfully, the domestic animals again furnish models, theory becoming fact under which thousands of generations have lived. The most perfect states are found among the social insects, foremost among which may be mentioned the honey-bee. This society, which man has had under domestication so many thousand years that the beginning has been forgotten, has won the admiration of the world. What could be more perfect, each member of the society being apparently free, and each laboring for the common good? Truly it seems an ideal state. But to attain this ideal state queens must kill their

* By Prof. Simon Henry Gage, of Cornell University, at Ithaca, N. Y. (Abstract of the opening address before the section of zoology of the A. A. A. S., at Columbus, Ohio, August 31, 1899.)

sisters, or be killed by them; thousands must be relegated to ceaseless toil, and kings exist but for a day.

This perfect state consists only of a queen-mother and her thousands of sexless slaves. All exist, not for their own individual pleasure, improvement, or happiness, but only for the community. If socialists will study this, and other examples, of states that have successfully worked out the social problem to a finish, they will perhaps get an inkling of how far off is the realization of all Utopias, of even the noble aspirations of our own national Declaration of Independence. Their realization is far-off and difficult, or impossible of realization, because the struggles of individualism are never compatible with perfect socialism. It is not possible to serve the state and the individual both with one's whole power. If there is partial service, as there must be in human society, neither the state nor the individual will have the most perfect development. The parallelogram of forces will give a resultant, to be sure, but so far this resultant has proved a tortuous and unsatisfactory line instead of the perfect forms of beauty dreamed of by the enthusiasts.*

Thus I have tried to show a few of the ways in which the study of domestic animals has thrown light on the problems confronting mankind in his social ideas, in preventive medicine, in physiology and hygiene, in embryology and comparative anatomy, and in the doctrine of the evolution of organic forms. The attempt has been made to show that, with the higher forms at least, those most closely related to man, and in whose destiny his own economic, hygienic and social relations are most closely interwoven, the domestic animals have served, and promise to do so in the future, the best purpose, because of the abundance of the material in quite widely separated groups of animals which have long been, and still are, under greatly differing conditions and surroundings; and finally because this material is plentiful and under control, and may thus be studied throughout the entire life cycle.

Man is a part of nature, and the modifications due to him show the plasticity of the forms under his control, and give proof of the capability of change by environment and selection. Furthermore, any wild form chosen for study has widely departed from its primitive state. Too great a tendency in biology yet exists to study what is remote and inaccessible, with a natural depreciation of what is near at hand. But no living forms are truly primitive throughout. They have been under stress for ages, though every group retains some primitive features. Even man himself is one of the best forms to study the limbs upon. As any complete study requires much material at all stages, the higher forms must be of the domesticated groups, or wild forms must be domesticated for the time being to supply the material.

Sordid interests should stand back. For the scientific mind the study of zoology for its own sake, that is, for an insight into the fundamental laws of life, is a sufficient incentive and reward. Yet no scientific man ought to feel anything but happiness to know that his work has added to the sum of human well-being. Perhaps no man ever expressed better the sympathy of a scientific man with his fellow men than did Pasteur in his preface to his work on the silkworm diseases.

Let me summarize by saying: However necessary and desirable it may have been in the past that the main energy of zoologists should be employed in the description of new species and in making fragmentary observations upon the habits, structure, and embryology of a multitude of forms, I firmly believe that necessity, or even desirability, has long since passed away; and that for the advancement of zoological science the work of surpassing importance confronting us is the thorough investigation of a few forms, from the ovum to youth, maturity and old age. And I also firmly believe that, whenever available, the greatest good to science and thus to mankind will result from a selection of domesticated forms for these thorough investigations.

THE OLDEST COAL MINE IN EUROPE.

FRANZ BUETTGENBACH, mining engineer, Aachen, Germany, who published last year a little book on this subject, has been dipping again into certain old documents and has reached the conclusion that the earliest coal mining operations antedated the period assigned in his first book. He now expresses the opinion that coal was mined much prior to 1113. It appears that coal was found in the Liege district about 1199, long after it had been found and worked in the Worm district, and no doubt is now entertained that in that district it was worked before 1113. In his "History of Coal Mining in Great Britain," Galloway says that it is probable that before the close of the reign of William the Lion (1214), coal was attracting some attention on the south shore of the Firth of Forth, and that during the reign of this king a grant of a tithe of the colliery of Carriden, near Blackness, was made to the monks of Holyrood Abbey, Edinburgh. This was 100 years after the mines in Worm district were opened and regularly worked.—Minerals and Mines.

It seems that upward of 65 locomotives for Indian railways are now being built in Philadelphia, says The Practical Engineer. These will be landed at various ports in that empire at an average saving of $2,000 on each engine, and in six months less time than our own makers who tendered could promise. The Philadelphians are manufacturing them for, roughly, $1,500 less than their British competitors, and they will pay freight and insurance, while the home maker would only deliver them at Glasgow, Liverpool, or London, and leave the Indian railway companies to pay all further charges. These latter charges mean over $500 for each locomotive. It is not averred that in the end this $2,000 will be all saved, or that an American engine is as good [!] as one made here, for where in many parts steel is used in the latter iron is substituted in the former. But time is a great object, and while we cannot guarantee delivery under a year, the Philadelphia people promise it in six months.

* The reader is referred to articles by Mrs. Anna Botsford Comstock on "Insect Socialism" in the Chautauquan for 1898, Nos. 4, 5, and 6.

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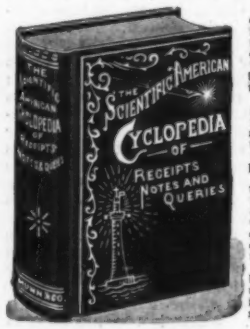

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